ASSESSING THE RELATIONSHIPS BETWEEN FOOD AND AFFECTIVE ITEMS USING THE HEDONIC GENERAL LABELED MAGNITUDE SCALE

By

BRITTANY MARTIN

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
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Brittany Martin

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Food and affective items are rarely measured using the same scale, but much can be learned about how individuals rate foods among their life experiences by doing so. Evaluation using the Hedonic general Labeled Magnitude Scale (HgLMS) allowed effective comparison of food and nonfood items. This scale ranges from the strongest disliking of any kind ever experienced (-100) to the strongest liking of any kind ever experienced (+100), and is personalized to individuals. The main objective of this study was to compare food and affective items using the HgLMS and to search for relationships between these items. Three hundred twenty-eight participants answered a questionnaire containing 179 items relating to foods and affective experiences using the HgLMS.

Results were analyzed using SPSS. Amalgamative groups of both foods and affective items were formed conceptually then tested for internal consistency using Reliability Analysis (Cronbach Alpha). Groups were correlated to individual smell and food related affect variables using Linear Regression. Results showed most groups were statistically significant for the smell and food related variables.

Participants were divided into “Foodie” and “Nonfoodie” groups. Analysis of variance (ANOVA) showed for positive groups, the Foodie mean was significantly higher and for negative groups the Foodie mean was significantly lower. Thus, Foodies have a stronger liking for foods than do Nonfoodies, and they rate affective items more intensely than do Nonfoodies. Individuals who get great pleasure from food are thus affectively more reactive.

Overall, results show food and nonfood items can be effectively rated on the HgLMS. Affective liking is often highly correlated to liking for foods.

CHAPTER 1
INTRODUCTION

Positive and negative experiences are common throughout life. Food and eating, which are integral parts of the human enterprise, are tied to affect. Foods and experiences can have positive or negative affect, and differences between what is liked and disliked varies between individuals.

Scales can be used to measure affect. The Hedonic general Labeled Magnitude Scale (HgLMS) measures affect on a scale ranging from the strongest disliking of any kind ever experienced (-100) to the strongest liking of any kind ever experienced (+100). The top and bottom anchors on this scale are personalized to individuals, meaning each participant's scale is potentially unique. The top and bottom participant anchors tend to be unrelated to food, and thus both food and affect items are measured in the context of pleasure (Bartoshuk and others 2003).

The HgLMS is superior to category scales because it allows participants to pick a representative number for their feelings based on their personal anchors. Conversely, the 9-point hedonic scale has no context other than its labels (like slightly, like moderately, like extremely, etc.) and cannot make valid across-group comparisons (Cox and others 2001). Unpublished data shows the HgLMS can create valid across-group and within-subject comparisons.

Food and nonfood items are rarely assessed on the same scale. One recent study did measure both on a scale analagous to the HgLMS, the generalized Degree of Liking Scale (gDOLS). However, the purpose of this study was not to compare food and nonfood items directly but to use these items to define whether or not an individual reacted more strongly to food than affect, and was therefore a "foodie" (Pickering and

others 2013). Direct comparison of food and affect items can lead to a broader picture of how individuals rate these items in their lives. Direct comparison can also show how liking for specific affect items can be correlated to liking for specific foods, and vice versa. This type of research has never been conducted before.

The purpose of this study is to directly compare the liking of food and nonfood items using the HgLMS. The information gathered from this study will be useful in understanding how individuals rate life experiences and foods, and will correlate liking or disliking of groups of affect and foods items to one another. This data may predict if liking or disliking for a certain variable will influence liking or disliking for another.

Individuals can also be divided into “foodies” and “nonfoodies” using their ratings of food and nonfood items on the HgLMS. It was hypothesized that foodies would rate both food and affective items more intensely (i.e. more positive or more negative) than would nonfoodies. This information is of interest to psychophysicists and food scientists, and may also be useful in food marketing.

Using the HgLMS enables variables to be easily broken down into both positive and negative responses. This allows variables to be assessed dichotomously. Dichotomous assessment can show which variables show wide variation in their hedonic value to different participants, and how these participants differ from one another in their response to other food or affect categories.

CHAPTER 2
LITERATURE REVIEW

Introduction to Gustation, Olfaction, and Flavor

The experience of eating foods is influenced by all five senses: Hearing, sight, touch, taste, and smell (Lawless and Heymann 1999). The most important of these senses with regard to food are taste and smell. Taste, known scientifically as gustation, is the perception of taste sensation on the tongue. The widely accepted basic taste qualities are sweet, salty, sour, and bitter; umami, a savory taste, is still debated upon as a fifth basic taste (Bellisle 1999).

The Tastants

Salty tastants are formed from two charged particles: a positively charged cation and a negatively charged anion. The most common and the saltiest tastant is table salt, NaCl. Sodium is necessary for humans to survive. Chloride deficiency has been shown to mimic sodium deficiency; infants who were accidentally fed a chloride free formula developed a lifelong preference for salty foods (Stein and others 1996). Saltiness perception is not static; a reduced sodium diet increases the perception of saltiness over time (Bertino and others 1982). Thus, a dietary reduction in sodium will lead individuals to label some foods they formerly found enjoyable as being too salty.

Sour tastants are acids, which biologically occur when the number of hydrogen ions in a solution exceeds the number of hydroxide ions. While most individuals enjoy sour tastes at a low level, high concentrations of acids are inedible and will cause damage to body tissues.

Bitter perception varies based on genetics, as will be discussed later. Bitter genes are located on three chromosomes: 5, 7, and 12. The bitter gene family, in

which there are 25 members, is Tas2r. However, most specific bitter receptors are still unknown. Many bitter compounds are poisonous, which is why individuals tend to reject strongly bitter foods. However, some bitter tasting foods are very healthful, including many vegetables. Bitter perception is also dependent on female hormone levels. Bitterness sensitivity is at its height for women during pregnancy, and significantly diminishes after menopause (Duffy and others 1998).

Sweet taste comes from sugars, which are simple carbohydrates. Glucose is the main energy source of most living things on Earth. There are only two sweet receptors: Tas1r2 and Tas1r3. These two receptors form a heterodimer which was initially thought to be responsible for all sweet perception (Bartoshuk 2012). This differs from the bitter receptors, where there are many Tas2r receptors which respond to a multitude of bitter compounds. This sweet heterodimer has a complex shape, so a variety of sweeteners with various chemical structures can bind at different places on the heterodimer.

While different sweeteners interact with disparate areas of the heterodimer, the receptor produces the same signal for every sugar. Thus, every sweetener, including artificial sweeteners, should all produce the same sweetness. However, a simple taste test will show that this is not the case. A genetic study involving the Tas1r3 receptor may provide a potential answer as to why this is: the Tas1r3 receptor was reported to have the ability to function alone, and only responds to large concentrations of sucrose (Zhao and others 2003). These findings could explain the difference we perceive between true and artificial sugars.

Liking and disliking for three tastants is present from birth. Human brains are hardwired to enjoy sweet sensations and to reject bitter and strong sour tastants. The

salty receptor is not mature at birth and develops in infancy, at which time infants will begin to enjoy dilute salty solutions. These hardwired taste affects were shown by Steiner, whose newborn subjects displayed a “smiling” expression when exposed to sweet followed by suckling. Sour tastants resulted in a pouting face. Bitter tastants elicited spitting, mouth gaping, and dry heaving (Steiner 1973).

Gustation Mechanism

Taste perception occurs through a sequence of events. First, mastication breaks down food into smaller molecules. These molecules are dissolved in saliva, which reaches the taste bud through a taste pore. Taste buds are located in specialized papillae on the tongue surface. The three major papillae involved in taste are fungiform, foliate, and circumvallate (Lawless and Heymann 1999). Fungiform papillae are located on the anterior of the tongue and reach a maximal diameter of 1 millimeter. Each fungiform papilla contains approximately six taste buds (Bartoshuk 2012). Foliate papillae are located on the sides of the tongue at the point where the tongue is attached, and circumvallate papillae form an inverted V at the back on the tongue. Taste buds are also found on the larynx, orolarynx, epiglottis, upper esophagus, palate (Bachmanov and Beauchamp 2007) and the gut (Hass and others 2010).

All taste nerve fibers were once believed to be connected on one end to receptors and to nerve fibers on the other end. The nerve fibers were thought to bring taste information directly to the brain. However, some receptors were found on cells which do not directly synapse with nerve fibers (Herness 2005). There are three different types of taste bud cells, each of which parlays different taste qualities. Type I cells do not have synapses and may respond to salts; very little is known about these. Type II cells respond to bitter, sweet, and umami. They have receptor sites but no

synapses. Type III cells mediate saltiness and sourness and behave typical to the model, with a receptor site as well as a synapse (Chaudhari and Roper 2010).

Taste cells are constantly regenerated and have a lifespan of about one week. This explains why the taste system can recover quickly from damage such as a burnt tongue, and why the elderly are able to taste. Taste receptor cells are located inside taste buds. Taste stimuli interact with taste receptors, and a neural message is created. These messages are carried to the brain by the three cranial nerves involved in taste: The facial nerve (VII), the glossopharyngeal nerve (IX), and the vagus nerve (X) (Lawless and Heymann 1999).

Taste information leaves the taste buds via the cranial nerves and travels through the medulla and thalamus before reaching the primary area for taste processing, the cortex (Bartoshuk 2012). The insular cortex is the primary processing area for taste and is also the first part of the cortex which receives taste information. The orbitofrontal cortex is also involved as it is able to integrate taste with other related entities: Temperature, smell, and touch.

Olfaction

Olfaction occurs when odor molecules are detected by olfactory receptors in the mucosa. Only volatile, small, hydrophobic molecules have the potential to be smelled. However, not all molecules which meet these criteria can be smelled (Herz 2012).

Volatile molecules sniffed through the nostrils result in orthonasal olfaction. This can be thought of as the normal smell of foods. Foods release volatiles during mastication; these volatiles are forced up behind the palate and enter the nasal cavity from the rear. This is called retronasal olfaction. Mastication breaks down the food matrix in the mouth and on the tongue. Maximum flavor intensity occurs near the

moment of swallowing, at the border of the back of the tongue and the soft palate (Buettner and others 2002). The overall flavor characteristic of foods is derived from retronasal olfaction (Bachmanov and Beauchamp 2007).

Olfaction mechanism

For olfaction to occur, air which is sniffed into the nasal cavity passes over ridges called turbinates. These add turbulence, which cause a small amount of air from each sniff to pass through the olfactory cleft; the air then reaches the olfactory epithelium. Olfactory sensory neurons (OSNs) are located on the olfactory epithelium. Dendrites on the OSN have olfactory receptors on their tips. When an odorant interacts with olfactory receptors, a signal cascade occurs, the end product being an action potential which is transmitted from the OSN to the olfactory bulb. For an action potential to be generated, seven or eight odor molecules must be bound to a receptor. Approximately forty action potentials must be generated before the sensation of smell occurs. Humans have nearly 20 million OSNs (Herz 2012).

Olfactory receptor cells

Olfactory sensory neurons are regenerated approximately once every 28 days. However, temporary anosmia, or lack of ability to smell, can be caused by head trauma, sinus infections, and sinonasal diseases such as polyps (Herz 2012). In rare cases, head trauma can lead to permanent anosmia. Specific anosmia can also occur; this is likely a genetic inability to smell specific compounds. One of the most common specific anosmias is to androstenone, a steroidal musk compound approximately half of the population is anosmic to. However, androstenone sensitivity was experimentally induced in half of individuals who initially were anosmic to it via repeated exposure (Wysocki and others 1989).

Olfactory receptor cells are the only sensory cells which are directly connected to the brain. Despite being directly connected to the brain, OSNs are some of the slowest axons in the body. There is a lag time of almost half a second between sniffing and an odorant being registered in the brain (Herz 2012). This does not include the time it takes to react to a scent, which makes olfaction a very slow sensation. Conversely, the visual cortex processes sight data almost instantaneously. Like taste, odors often have a feel in addition to a smell (Herz 2012). For example, menthol has a cooling feel while horseradish has a burning feel. This is because the trigeminal nerve (Cranial Nerve V) innervates the nasal cavity.

Odor detection

Olfactory detection thresholds are dependent upon a number of factors. One is the length of the carbon chain of a molecule: the longer the carbon chain, the easier the molecule is to detect (Herz 2012). Females have lower detection thresholds than do males, particularly when ovulating. Despite common belief, olfactory sensitivity does not increase during pregnancy (Cameron 2007). Olfactory sensitivity has been shown to increase throughout the day, with short decreases in sensitivity after food is consumed (Goetzl and others 1949). Detection thresholds increase as individuals age because cell death exceeds the rate olfactory receptor cell regeneration.

Odor hedonics

Odor hedonics can measure how much individuals enjoy particular smells. Overall, individuals like odors they are familiar with. Ratings of odor pleasantness form a linear relationship with odor liking (Herz 2012). It is clear most olfactory affect is learned. There is disagreement as to whether any smells are innately liked or disliked. Conditioned preference may play a role. Odor liking or disliking can be conditioned in

babies by the positive or negative reactions of adults to the same odor. Positive or negative consequences associated with an odor may also be a factor in conditioning. Conditioned preference is supported by infant research, which shows infants do not find the smells of feces or sweat disgusting (Engen 1982). Infants also like odors better if they were exposed to them in utero. This includes strong, distinctive smells such as tobacco, alcohol, and garlic (Menella and Beauchamp 1991, 1993).

Cultural differences exist in what is considered an acceptable smell. For example, most Westerners enjoy cheese, an often strong smelling food. However, many Asians find cheese to have an unpleasant smell, but will eat natto, a fermented soybean dish many Westerners find noxious. Learned taste aversion is an olfactory phenomenon. When an individual or animal becomes sick after ingesting a specific substance, they will often refuse to eat this substance in the future. However, this conditioned aversion is due to the smell of the food, not the taste (Bartoshuk and Wolfe 1990).

Memories arising from odor cues are distinct in their emotionality. When individuals are asked to list emotions associated with a memory, they list more emotions related to olfaction than to others senses (Herz 1998, Herz and others 2004). Emotions are also more intense when they were linked to smell rather than the other senses. Individuals report a stronger feeling of being transported back to the original moment with odor memories than with memories elicited by others senses.

Pleasantness of Odors and Tastes

The pleasantness of food odors can change depending upon whether an individual is satiated. For example, after eating until full, a formerly pleasant smell such as cheese or chocolate may become unpleasant, while the perceived pleasure of

nonfood odors is unchanged (Cabanac 1979). Similarly, drinking a sweet juice until full will not affect liking for a salty stimulus, but the liking for a different sweet stimulus will be lower than it would be on an empty stomach. However, these observations may not be valid cross-culturally (Moskowitz and others 1975).

Flavor

Flavor is the amalgamation of retronasal olfaction and taste. Minorly, orthonasal olfaction, mouthfeel, trigeminal sensations, and appearance can also contribute to an individual's perception of flavor (Rozin 1982). Flavor processing is supported by the caudal orbitofrontal cortex, which integrates input from both taste and retronasal components (de Araujo and others 2003). Thus, flavor exists as a unified sense only because it is constructed cognitively from the two sensory systems it originates from (Prescott 1999). Because of this complex unification, retronasal olfaction is often confused with taste. For example, an individual with a cold may complain of not being able to "taste" food. However, this statement is false as they can still taste the basic tastants (sweet, salty, sour, and bitter) but lack the normal intensity of flavor they are accustomed to due to their inability to perceive the odors retronasally (Rozin 1982).

Retronasal olfaction and taste can intensify one another. Some experts believe volatiles which smell sweet increase the perception of sweetness, despite having no taste themselves. For example, strawberry volatiles enhance sweetness quality while peanut butter volatiles do not (Frank and Byram 1988). Like only intensifies like, so the perceived saltiness of a salt solution would not be enhanced by the addition of strawberry volatiles.

Differences in Taste Ability

There are substantial taste sensitivity differences amongst individuals, particularly in regard to bitter compounds. The first to discover this was A.L. Fox. In 1932, Fox and a lab mate accidentally tasted phenylthiocarbamide (PTC), and found they had differences in ability to taste the compound (Fox 1932). Some individuals found the compound tasteless (nontasters), while others found it strongly bitter (tasters). This eventually led to the understanding that taste ability is influenced by genetics. Less ability to taste bitter compounds is indicative of an individual possessing two recessive alleles for bitter, later found out to be located on chromosome 5 (Blakeslee and Salmon 1931, Reed and others 1999).

PTC is no longer used to determine taste sensitivity because it is toxic (Wheatcroft and Thornburn 1972). Instead a chemical relative, 6-n-propylthiouracil (PROP) is often used to test taste. However, PROP is a drug used to treat hyperthyroidism. Although only a fraction of the medicinal dosage of PROP is used to test taste, some individuals may not wish to use it due to its drug status. Both PTC and PROP contain an N-C=S group, which exhibits bitter qualities.

Early on, taster status research utilized category scales to determine taste sensitivity. A major issue with these types of scales was that a given descriptor (e.g., strong or weak) could denote different actual perceived intensities to different individuals (Bartoshuk and others 2004). This diminished the power of the category scale. Many differences in perception are due to genetics. Some individuals can be classified as supertasters: individuals who experience the most intense taste sensations.

In the United States, about 25% of the population can be classified as supertasters. Supertasting was discovered during PROP studies. More current work has shown supertasting is general and affects virtually all taste experiences.

The general Labeled Magnitude Scale (gLMS) was developed by Bartoshuk and others to allow for valid across-group comparisons. Supertasters perceive more intense sensations for all basic taste qualities when compared to nontasters and medium tasters. For example, the perceived sweetness of sucrose is higher for supertasters than nontasters (Bartoshuk and others 1978). Supertasters tend to have the most fungiform papillae. Thus, other oral sensations such as oral burn from spicy foods or oral touch from fats are also experienced as being more intense by supertasters. This is because fungiform papillae are innervated with nerve fibers which detail oral touch and trigeminal sensations as well as taste. Individuals who experience the most intense taste also experience the most intense retronasal olfaction, and thus the highest perceived flavor.

Supertasters tend to be pickier eaters than others. Because bitter tastes are more intense for supertasters, they are less likely to enjoy foods which contain bitter compounds, including vegetables. Significantly fewer tasters are smokers and alcoholics, as the strong tastes of these two substances are apparently repugnant to many tasters (Duffy and others 2006).

Sensory Evaluation

Sensory evaluation is important to the food industry as it assesses consumers' responses to food products. Without sensory evaluation, manufacturers could not approximate how consumers perceive a product before putting it on the market (Sidel and others 1981). Companies can also determine if consumer panelists notice a

formula change or enjoy the taste of a “new and improved” product using sensory evaluation (Lawless and Heymann 1998). Other important product aspects, such as shelf life and packaging functionality, can also be assessed (Lawless and Heymann 1998).

Early Sensory Evaluation Methods

Just noticeable difference

One of the earliest examples of sensory evaluation applied to food is Fechner’s just noticeable difference (jnd) scale (Stevens 1960). Created in 1850, this scale measures slight differences between items using an unlabeled scale. Specifically, jnd is the smallest detectable difference between the beginning and secondary level of a sensory stimulus. Error along this scale was incorrectly assumed to be constant, which although false, largely shaped the psychophysical world through the early 1900s (Stevens 1960). The jnd scale did not take into account the asymmetry of sensitivity: it is easier to discriminate tastants at similar concentrations near threshold than it is at very high concentrations.

With the advent of the Pure Food and Drug Act of 1906, the food industry began to grade products, and professional grades assessing the quality of foods were established (Meilgaard and others 1999). As the field of product quality assurance grew, sensory evaluation became more scientific. Scorecards containing product descriptions were used to differentiate product grades beginning in the early 1900s (Hinreiner 1956).

Nine-point scales

One of the oldest and still most widely used scales is the nine-point category scale. This scale was first developed by the United States Natick Laboratories to rate

soldiers' acceptance of military rations (Jones and others 1955). The original scale had nine labeled points expressing sensory strength, ranging from none (1), slight (3), moderate (5), strong (7), to extreme (9). A variation on this scale is the hedonic nine-point scale; this scale ranges from dislike extremely (1), neither like nor dislike (5), to like extremely (9).

One issue with the hedonic nine point scale is the large amount of variability seen between panelists (Sidel and others 1981). Also, nine-point scales do not have ratio properties. Thus, when a panelist rates a product a 6, it does not necessarily mean he likes the product twice as much as one he rates a 3. However, the nine point hedonic scale is still very useful for measuring hedonic response, as it requires very little panelist instruction and works well for within subject comparisons.

Magnitude estimation

Category scales make it difficult for individuals to define the magnitude of sensory differences between two products. Stevens and colleagues developed a scaling method based on ratio properties, termed magnitude estimation, to address this shortcoming (Stevens 1957). To use magnitude estimation, panelists assign an initial sensation a numerical value, then rate further sensations based on their intensity compared to the initial value. For example, if a panelist labeled the sweetness of an initial solution a 10 and found a second solution to be half as sweet, he would rate the second solution a 5. The numbers picked are inconsequential; only the ratio created between the taste sensations is important. As with category ratings, magnitude estimation ratios fail to provide valid across-subject comparisons.

Stevens' work was expanded to matching taste sensations with other sensations which are not taste related. For example, the strength of a tastant can be compared

with the loudness of a tone (Stevens 1960). This procedure is called “cross-modality matching” and provided the basis for subsequent scales such as the gLMS. These across-group comparisons are useful because when unrelated standards are used, the data can be separated into taster groups: supertasters and others. Supertasters will match the intensity of a solution to a louder tone than others.

Modern Sensory Evaluation

Visual analogue scale

The advent of modern sensory evaluation dawned with the Visual Analogue Scale (VAS). The VAS measures sensation on a 100 mm line, with each endpoint being an extreme. For example, a 1969 study by Aitken measured apprehension in fighter pilots based on ten imagined situations. One end of the scale was labeled “maximal panic” while the other was labeled “maximal relaxation”, and the pilots made a mark on the line to denote how they felt in each situation (Aitken 1969). Scales such as the VAS are valid for within subject comparisons as well as across group comparisons when groups are large and randomly assigned (Bartoshuk and others 2003). However, this scale cannot be used to make demographic comparisons (sex, age, etc) because the intensity labels do not refer to the absolute perceived intensity of each group.

Labeled magnitude scale

The creation of the Labeled Magnitude Scale (LMS) was a significant breakthrough in sensory scaling. This scale, devised by Green and colleagues in 1993 (Green and others 1993), was similar to scales devised by Borg (Borg 1982), Moskowitz (Moskowitz and Sidel 1971), and Gracely (Gracely and Kwilosz 1988) all of which gave category scales ratio properties by re-spacing the labels. The LMS is a labeled scale for oral sensations. The scale ranges from a bottom anchor at “no sensation” (0) to a top

anchor at “strongest imaginable oral sensation (100)” (Green and others 1993). Included are the descriptors between those anchors with intermediate labels for “barely detectable”, “weak,” “moderate,” “strong,” and “very strong.” The LMS has ratio properties, so an oral sensation rated a 40 should be twice as intense as one rated 20.

Oral burn was previously assumed to be similar amongst all individuals. However, this is not true, as taste buds are encompassed by nerve fibers which parley oral burn (Finger and others 1994). The number of taste buds an individual has is related to PROP perception and taster status (Bartoshuk and others 1994). Oral burn is stronger for supertasters than for nontasters. Thus, the LMS is not a viable means to compare participant perceptions for taste.

General labeled magnitude scale

The general Labeled Magnitude Scale, or gLMS, was created to address concerns raised by the LMS. The gLMS was stretched to encompass the maximal imagined possibility of a sensation as well as the minimal. Thus, the top anchor, 100, was the “strongest imaginable sensation of any kind” while 0 is “no sensation” (Bartoshuk and others 2003). Valid comparisons can be made across taster groups, as the top anchor is thought to be equal across all groups, so long as the top anchor is not related to taste. To ensure participants understand how to correctly use the scale, they are often asked to rate the intensity of a series of items which have an intuitive order. For example, three statements commonly used are the loudness of a whisper, the loudness of a conversation, and the loudest sound ever heard. If these three items are not rated in this ascending order, an individual likely does not understand how to use the gLMS.

The word imaginable was removed from the top anchor of the gLMS because it detracts from universality (Snyder and others 2008). While there is some correlation between imagined and experienced sensations, the term imaginable creates problems due to the differences in the imaginations of individuals, and removing this term makes the scale stronger (Snyder and others 2008). The new top anchor is the "strongest sensation of any kind ever experienced" (Snyder and others 2008).

Currently, the gLMS is the most powerful sensory tool allowing valid between group comparisons (Bartoshuk and others 2004). This scale best reflects the effects bitter compounds such as quinine produce, which can also be linked to fungiform papillae density (Bartoshuk and others 2003). The gLMS is a valuable measure of absolute intensities of sensations among and between groups.

Hedonic general labeled magnitude scale

The hedonic general labeled magnitude scale, or HgLMS, measures hedonic responses to foods and affective experiences. Created by Bartoshuk and colleagues in 1997 and modified as the gLMS was modified, this scale is an improvement on the 9-point hedonic scale. It is specifically a hedonic gLMS scale created for the hedonic evaluation of foods; the HgLMS essentially takes two gLMS scales and places them together. This scale is personalized by individuals, with -100 being the "strongest disliking of any kind ever experienced" and +100 being the "strongest liking of any kind ever experienced". Zero is neutral, and no other anchors are used on this scale.

The HgLMS gives good across-group comparisons for taster groups because an individual's strongest liking or disliking is rarely food related (Bartoshuk and others 2006). Because of this, the HgLMS allows valid across-group and within-subject comparisons for food preferences (Kalva 2009). As this scale is relatively novel in the

sensory world, it requires more verbal instructions to ensure panelists understand how to use it.

The HgLMS and scales with similar labels are improvements over the hedonic nine-point scale and other category scales. Many individuals do not use the end points (1 and 9) on the hedonic nine-point scale, creating what is referred to as the ceiling effect. Hedonic labeled scales eliminate this effect because they are continuous; participants are more likely to make marks throughout the scale (Cardello and others 2008). A recent study showed the HgLMS is superior to the hedonic nine-point scale because it limits the ceiling effect and creates stronger correlations when comparing demographics such as gender and foodie status (Kalva 2009).

Kalva's study showed individuals who experience more intense taste sensations also experience greater liking and disliking for their favorite and least favorite foods. Her study also found significant positive correlations between liking for food and music, as individuals who rated the variable Listening to Your Favorite Music highly also rated Eating Your Favorite food highly. Rating of foods from memory using the HgLMS was shown to be highly correlated with HgLMS ratings of the same foods when they were tasted in a panel session. Thus, rating from memory with the HgLMS is likely an efficacious way to assess food products (Kalva 2009).

Neuroscience of Hedonics

The orbitofrontal cortex is the part of the brain which links sensory and motor information, resulting in goal oriented behavior and emotional processing (Rolls 1999). Specifically, the medial and lateral areas of the orbitofrontal cortex may act together to create behaviors which modify end goal oriented behavior; eating is one of these behaviors (Kringelbach 2005). Neuroimaging studies show the orbitofrontal cortex

exhibits the hedonic value for both abstract secondary reinforcers, such as money, as well as primary reinforcers, such as eating (Kringelbach and Rolls 2004).

When the orbitofrontal cortex is damaged patients often exhibit flat affect, inappropriate social behavior, and trouble making decisions (Rolls and others 1994). Signals most individuals take for granted, such as interpreting vocal and facial expressions, are impaired in individuals with frontal lobe damage (Hornak and others 1996). Similarly, when individuals process angry faces, a sign that social behavior is likely inappropriate, the orbitofrontal cortex is activated (Schnider 2003). Brain activity in the orbitofrontal cortex has been related to pleasantness ratings for food eaten to satiety (Kringelbach and others 2003). Up to now, intensity ratings cannot be correlated with activity in the orbitofrontal cortex, as shown in studies using both taste and odor (de Arujo and others 2003, Anderson and others 2003).

Pleasure as a Currency for Emotion

Cabanac asserts pleasure, also called “affect”, is the common currency of emotions (Ramirez and Cabanac 2003). He defines emotion as “any mental experience with high intensity and high hedonic content” (Cabanac 2002). If disparate emotions have a common currency, it is pleasure (Ramirez and Cabanac 2003). Rating foods from memory, as is done in our study, involves rating the pleasure elicited from experiences. The HgLMS is the ruler by which these nonsimilar items can be assessed. In this case pleasure related to food and affective experiences is measured on the same scale, and the pleasure felt is the common “currency” between unlike items. Under this theory, it is intuitive that foods and nonfoods could be compared to one another.

Using Scales to Compare Food and Nonfood Items

Few studies have compared food and nonfood items on the same scale. A recent study by Pickering studied foodies and wine experts (Pickering and others 2013). Liking for 14 nonfood items and 64 food items were measured on a generalized Degree of Liking scale (gDOLS), which is analogous to the HgLMS. Individuals were considered “foodies” if their average food score was higher than their average nonfood score. The nonfood items were both affectively positive and negative; approximately half of the items were positive and half of the items were negative. This study was interested in making comparisons between different demographic groups (age, sex, income, etc.).

Food and affective items are rarely compared on the same scale because researchers in the fields of psychology and psychophysics believed it cannot or should not be done. Specific scales were developed to assess emotions, others were developed to assess foods, and the two are almost never mixed. However, the HgLMS has the power to assess both food and affect. If, as Cabanac says, pleasure is the currency of emotion, then degree of pleasure or displeasure is the common denominator with which all items can be compared. The anchors participants chose on the HgLMS can be thought of in the same way a tone is used in cross modality matching: these most liked and disliked experiences are the “tone” to which participants estimate the pleasure or displeasure of an unrelated situation.

The time to assess food and nonfood items together is now. The HgLMS is a powerful tool which has the ability to compare participant liking for unlike items, and much can be learned when food and affect are measured on the same scale.

CHAPTER 3
MATERIALS AND METHODS

Participant Recruitment

The University of Florida Health Science Center Institutional Review Board (IRB) approved the study protocol. Five hundred participants were recruited from FOS 2001 Man's Food class via messages on Sakai, and from regulars of other panels via e-mail. All ages 18 and above were considered for participation. Participants were screened based on their willingness to spend thirty minutes answering a questionnaire. Three hundred sixty-nine participants completed the questionnaire; the other one hundred thirty-one panelists did not make their appointment. Before beginning the questionnaire, participants read and signed the IRB approved consent form. Participants were compensated for participating in the study.

Sensory Laboratory

Participants answered the questionnaire at the Sensory Laboratory at the Food Science and Human Nutrition Department in individual booths with computer workstations. Each work station was equipped with a sensory software program to collect data (CompuSense® Five Sensory Analysis Software for Windows, Compusense, Guelph, Canada). Paper scales and a pencil were kept at each booth so participants could write on and refer back to the top and bottom anchors of their scales for the duration of the questionnaire.

Questionnaire Design

At the beginning of the session, participants answered a series of demographic questions. The demographic data collected were: gender, age, height (in feet and inches), weight (in pounds), ethnic background, race, incidence of otitis media (middle

ear infection), vegetarianism, and smoking incidence. Individuals who identified themselves as vegetarians were asked to pick their top reason for being vegetarian from a list and to identify which meat products they had eaten in the past month from a checklist. Individuals who said yes to smoking more than 100 cigarettes or approximately 5 packs in their entire life were asked a follow-up question about their current smoking habits. The panelist's height and weight were used to calculate their body mass index (BMI). BMI was calculated using the following equation:

$$\{[(\text{weight in lbs})/(\text{height in inches})^2]*703\}$$

(National Institute of Diabetes and Digestive Kidney Diseases. National Institutes of Health. November 2008).

All participants were trained to use the Hedonic general Labeled Magnitude Scale (HgLMS). This scale was used to measure participants liking or disliking for certain activities, foods, and life events (Bartoshuk and others 2006). The HgLMS allows individuals to create a personalized scale ranging from "the strongest liking of any kind ever experienced" (+100) to "the strongest disliking of any kind ever experienced" (-100), with the flexibility for participants to select any integer between the two anchors on this scale.

Each participant identified and recorded on a provided paper scale their +100 and -100 experiences. Some examples of these experiences were given to the participants during training: falling in love, traveling, and spending time with family and friends were given as examples of +100. Being very ill or the death of a loved one were given as examples of -100. The participants' recorded +100 and -100 experiences remained their top and bottom anchors for the entirety of the questionnaire. Participants

were given the opportunity to take their paper scales with them after they completed the questionnaire so their HgLMS anchors could remain private. The HgLMS can be seen in Appendix A.

Participants were given brief instructions on how to use the HgLMS; all groups of participants were given identical instructions. Participants were told to keep their scale in mind while answering the questionnaire. The example given to demonstrate this was if you like dancing more than apples, *Dancing* should be given a higher value than *Apples* using the scale. For negative statements, the example was if you dislike seeing a roach more than you dislike eating broccoli, *Seeing a Roach* should be given a more negative value on the scale. Participants were also instructed to give an item a rating of zero if they neither like nor dislike it, and to not agonize over choosing a value but instead to quickly pick a number which they felt was representative and natural before moving on to the next item.

Participants were allowed to answer the questionnaire at their own pace. The questionnaire was comprised of 179 items. The majority of these items were created by doctoral candidate Jennifer Stamps in the Dental Department at the University of Florida. Food and affective items were included which were hypothesized to be both liked and disliked by participants, and of both strong and weak intensity. This was so the items in the questionnaire would create a range of responses on the HgLMS.

Items were randomized for each of the five test days in the following manner: the list of items was divided into specific foods (65 items) and experiences/activities, termed affective items (114 items). These two subsets were then randomized before creating blocks. Ten blocks were formed from these randomized lists, five blocks had 6

food items and 12 affective items, four blocks had 7 food items and 11 affective items, and one block had 7 food items and 10 affective items. Once the 10 blocks were formed, the 17 or 18 statements within each block were randomized. Participants would see one block of questions at a time, and could change answers to items already rated within each block; however, they were unable to search between blocks or go back to an earlier block to change an answer. Each panelist performing the test on a particular day would receive the same pseudo-randomization. True randomization could not be accomplished in the statistical software used due to the large number of items in the questionnaire. The randomized blocks assessed by participants on the first day of testing can be seen in Appendix B.

Once each participant finished the questionnaire, they were given individual verbal instructions for creating their top anchor on the general Labeled Magnitude Scale, or gLMS. This scale was used to measure the participants' perceived intensity of a bitter solution (0.001 M quinine) (Bartoshuk and others 2004). The gLMS allows individuals to develop a personalized scale ranging from "no physical sensation" (0) to "the strongest physical sensation of any kind ever experienced" (100). As with the HgLMS, participants are able to select any integer value between these two values when answering questions. Each participant identified their own "strongest physical sensation of any kind ever experienced," which is typically unrelated to food. Participants were not given any examples for what common 100 anchors are unless they specifically asked. Those who asked were told some common examples are the brightest light ever seen (usually the sun), the loudest sound they had ever heard, or the most pain they had ever been in.

Participants then used their gLMS scale to practice magnitude matching experiences for memory, including the loudest sound ever heard, the loudness of a conversation, the brightness of a dimly lit room, the brightest light ever seen (usually the sun), the loudness of a whisper, and the brightness of a dimly-lit restaurant. After this warm-up, the gLMS was used to rate the intensity of a 0.001 M quinine solution. Panelists tasted 5 mL of the quinine solution at room temperature, and rated its intensity using the gLMS to determine taster status.

Statistical Analysis

Statistical Package for the Social Sciences (SPSS) was used to analyze data. Forty-one participants were eliminated from the dataset because they rated either the loudness of a whisper higher than the loudest sound ever heard or they rated the brightness of a dimly lit restaurant higher than the brightest light ever seen on the gLMS. This indicated these individuals were not paying attention during the test, or that they did not understand scaling. These individuals were therefore eliminated from the dataset. The remaining 328 panelists were included in the final data analysis.

Groups encompassing several like-variables were formed from multiple variables using the Transform Variable Function. Amalgamative groups were formed instead of correlating individual items because more information can be gleaned from comparing groups of similar items than comparing items one-on-one, as one-on-one correlations are often difficult to interpret. Groups with conceptual cohesiveness are easier to compare to one another. For example, it is fairly easy to interpret a negative correlation between an amalgamative grouping of variables labeled Amusement/Excitement and Anger/Anxiety. Participants who value Amusement/Excitement have strong negative

feelings for situations which elicit Anger/Anxiety. However, interpreting a negative correlation between *Dancing* and *Losing Your Keys* is not as straightforward.

The first step to forming amalgamative groups was to group variables conceptually. These groups were tested for efficacy using the Reliability Analysis Function, which is a Cronbach Alpha test. This test measures internal consistency of a group consisting of multiple variables. The Reliability Analysis function can also state what the Cronbach Alpha would be if a variable was eliminated from a group. Thus, if a variable decreased the Cronbach Alpha of an initial group it was removed, despite that it seemed at first glance fit conceptually with the group. Correlations and regressions were made by graphing a scatterplot using the Chart Builder Function, and a correlation line with the coefficient of determination (R^2) was added. Significance and R-Values, or correlation coefficients were calculated using the Linear Regression function. For the Foodie and Nonfoodie analysis, Analysis of Variance (ANOVA) was used.

Another method was used to potentially group the variables, but was ultimately rejected. This was Rotated Component Matrix Factor Analysis, which was used to analyze foods and affective items separately. Allowing SPSS to automatically separate the data into factors led there to be far too many (20+), with some of the factors having only two or three variables each. This analysis also allows one to manually manipulate groups by specifying how many factors are wanted; from 2-10 factors were tried for affective items and from 2-8 factors for foods. However, all of these analyses produced groupings which were not conceptually cohesive and which had fairly low levels of significance for many variables. This is why the conceptual groups were ultimately selected conceptually and tested with Cronbach Alpha for cohesiveness.

CHAPTER 4
RESULTS AND DISCUSSION

Data from 328 participants was analyzed. Sixty-five percent of the participants were female and 86% were in the most common age bracket for college undergraduates (18-22). Two-thirds of participants described themselves as White or Caucasian. The demographic information collected can be found in Table 4-1. None of the demographic data were used in statistical analysis. For some demographic attributes, too few participants met an inclusion criterion for analysis. For example, few participants were current smokers (n=3), vegetarians (n=13), and sufferers of otitis media (n=13), so these variables were not analyzed. Other demographics, such as gender and BMI were analyzed, but no significant differences were found.

Creating Groups

The goal of this study was to look for meaningful relationships between liking for foods and affective items and to condense this data into results which were easy to understand. Due to the large nature of this dataset, correlating items individually is a difficult task, and the results are hazy. What does it mean if *Black Coffee* is significantly correlated with *The Most Enthusiastic You've Ever Been about a Hobby*? It was thought the best way to compare foods and affective items would be to place them in conceptual groups. Each item was placed into only one group. The groups were then tested using the Cronbach Alpha test, which measures internal consistency. This estimates the reliability of a psychometric grouping. The closer the Cronbach Alpha is to 1.0, the stronger the group is. While several iterations of groupings were tested using Cronbach Alpha, Table 4-1 shows the food and affective groups which conceptually seemed cohesive and also had high Cronbach Alphas.

Affect Groups

The chosen affect categories were Amusement/Excitement, Anger/Anxiety, Disgust/Fear, Guilt/Shame, Health Related, Satisfaction/Contentment, and Sensory Pleasure. Table 4-2 details the groups, included variables, and the mean participant response for each variable. The Amusement/Excitement group contained items which generally are very joyous, exhilarating, or amusing. The items in this group vary in intensity, but none is mild. In fact, 4 of the top 5 rated variables in this dataset (*The Most Joy You've Ever Felt, Learning Your Greatest Wish has Come True, Your Proudest Moment,* and *Falling in Love*) were from the Amusement/Excitement group. The mean ratings for this group vary from a low of 34.6 *(Dancing*) to a high of 90.1 (*The Most Joy You Have Ever Felt*).

The Satisfaction/Contentment group also had highly rated variables, but these variables differed from those in the Amusement/Excitement group. Initially, items such as *Sharing an Intimate Moment with Someone You Love* and *Graduating From High School* were thought to be better matches for the Amusement/Excitement group, but a Cronbach Alpha test showed these variables took integrity away from the Amusement/Excitement group, and fit better with Satisfaction/Contentment. The Satisfaction/Contentment group showed more variation overall than did items in the Amusement/Excitement group. For example, some low rated items including *Gardening* (0.1) and *Cleaning Your House* (4.6) were not universally appealing to all individuals, but they still added integrity to the Cronbach Alpha grouping of Satisfaction/Contentment. Most likely, many participants find performing these tasks satisfying, while some do not.

The Sensory Pleasure group contained items which all directly relate to one of the five senses: Taste, smell, touch, sight, or hearing. Items in this group were all positive and were all rated in the middle portion of the positive part of the scale. *Eating Your Favorite Food* had the highest mean variable rating in this group (61.4), while *Smelling Your Favorite Flower* had the lowest mean rating (24.3).

The Anger/Anxiety group included items which could cause participants frustration or stress. The most negatively rated item was *The Angriest You've Ever Been* (-74.3) while the highest rated item was *Forgetting an Old Friend's Name* (-29.5). This group had overall similar ratings to the Disgust/Fear group, which appertain to repugnance and aversion. When the Anger/Anxiety and Disgust/Fear group were experimentally combined into one, the Cronbach Alpha levels decreased and it was decided these variables should be kept separate. The most negatively rated item in this group was *The Most Disgusting Thing You've Ever Eaten* (-63.3) while the highest rated item was *Anticipating a Test Result* (-23.2).

The Guilt/Shame group was interesting in its wide range of response means, as well as the inclusion of a positively rated variable in a category which is so negative. The highest rated variable was *Speeding* (12.3) while the lowest rated was *The Guiltiest You've Ever Felt* (-72.0). Due to the positive mean of *Speeding,* it was experimentally added to the group Amusement/Excitement to see if it fit better there. However, taking this variable out of the Guilt/Shame group lowered the overall Cronbach Alpha for the Guilt/Shame group, and adding it to the Amusement/Excitement group lowered this group's Cronbach Alpha as well. Although *Speeding* has a positive mean, many

participants rated this variable negatively, so it fits better in a negative group like Guilt/Shame than one as positive as Amusement/Excitement.

The category Health Related included anything pertaining to sickness, doctor's visits, and death. This was the most negatively rated of all of the groups, with the lowest rated item being *The Death of a Loved One* (-93.3), and the highest rated item being *Going to the Doctor* (-14.4). While this group contains many variables which are also fear related (*Learning You Only Have a Few Months to Live, Finding A Suspicious Lump on Your Breast or Testicle*), these items were kept separate from the Disgust/Fear group because they specifically pertained to an individual's health.

A few of the affect items did not fall into any of the chosen categories. Six affect related variables were not used: *Being by Yourself, Being Defiant to Help Correct an Injustice, Entering a Haunted House, Looking Down From a Great Height, Finding out No One was Hurt in Your Loved One's Accident* and *Speaking in Front of an Audience.* These variables, with the exception of *Finding out No One was Hurt in Your Loved One's Accident*, likely did not fit any single group because individuals may have very different opinions of these variables.

Being by Yourself is a good example of this. One hundred twelve participants rated this variable as being negative (-99 to -1), and the mean negative rating was -35.0. One hundred-eighty panelists rated *Being by Yourself* positive (1 to 100), with the mean positive rating being 49.0. Sixty-seven panelists rated this variable as being completely neutral, or 0. This can be contrasted with a variable such as *Spending Time with Loved Ones*, which was universally enjoyed by panelists, meaning no one had a negative or neutral response. It seems many of the variables which could not be

grouped can be divided into subgroups: in this example, people who enjoy being by themselves (N=180), those who are indifferent to it (N=67), and those who dislike it (N=112). A few dichotomous variables are discussed in more detail later.

Finding out No One was Hurt in Your Loved One's Accident didn't fit into any group for a different reason. This variable implies a great amount of relief and thankfulness which is not conveyed by many other items in the dataset, except perhaps *Having a Reason to Believe a Problem is About to Get Better; Meeting a Major Deadline on Time; and Learning Your Greatest Wish has Come True*. However, these variables did not coalesce well as a single grouping, and the other relief oriented variables fit much better into other groups (Satisfaction/Contentment for the first two and Amusement/Excitement for the third one) than they did as a single group, proven by a Cronbach Alpha test.

Food Groups

The foods were more difficult to coalesce into groups with conceptual sense and high Cronbach Alphas than were the affective items. Only approximately half of the variables (34 of 64) were formed into groups. Groups with their included variables and participant mean ratings for the variables are detailed in Table 4-3. The groups decided upon were High Fat Sweet, Sweet, High Fat Savory, and Alcohol. Placing food items in these groups was an easier process than grouping the affective items due to narrow definition of the food groups. Conceptually, items in the High Fat Sweet group had to have a large amount of both sugar and fat while the Sweet group should be sweet with no or very little fat. Items in the High Fat Savory group should be fatty without being sweet. The Alcohol group included all items which were alcoholic beverages. The High

Fat Sweet group was the most liked, with the ratings ranging from a high of 41.7 (*Cookies, Cake, or Pastries*) to a low of 28.2 (*Oreo Cookies*).

As a whole, the affect associated with foods and beverages was only moderately intense. All foods and beverages were rated between 41.7 (*Cookies, Cake, or Pastries*) and -10.9 (*Black Coffee*). Most of the 64 food items were rated positively; only 7 (10.9%) were rated negatively. These items were *Hot Peppers* (-0.6), *Mayonnaise* (-0.8), *Vodka* (-1.0), *Ginger* (-1.9), *Bleu Cheese* (-6.1), *Whiskey* (-10.8), and *Black Coffee* (-10.9). Conversely, 57 emotion items (49.6%) were rated negatively, showing participants disliked the experimental affect items more than they disliked the foods.

Mean Graphs

Figure 4-1parts A-D shows the means for all of the individual food and affective items presented in quartiles. Quartiles were used because it is not possible to present all 179 items graphically on one page The top quartile contains mostly affective items, with the exception of the two items *Cookies, Cake, or Pastries* and *Ice Cream*. The mean variable ratings in this quartile range from a high of 91.0 (*The Most Joy You've Ever Felt*) to a low of 36.7 (*Making Up a Tasty New Recipe*). The second quartile contained many more food items than the first quartile, with the majority of items (76%) being foods. This quartile had means ranging from 36.0 (*Bread*) to 14.1 (*Plain Broccoli, Cooked*).

The third quartile contained both positive and negative items; 53% of the items were positive. Sixty-two percent of all items were foods in this quartile; however, 88% of the positively rated items were food while only 33% of the negatively rated items were food. Of the negatively rated items, the foods were also some of the most mildly rated,

being 7 of the first 9 negatively rated items. Again, this shows affective items were rated more intensely than food items in this dataset. The third quartile had variable mean ratings ranging from a high of 13.3 (*Marshmallow*) to a low of -34.2 (*Taking a Test and Not Knowing How You Performed*). The bottom quartile contained only affective items. These items had ratings ranging from -34.2 (*Getting Lost*) to -93.3 (*The Death of a Loved One*).

These mean graphs show an interesting trend. Affective items are rated more strongly positively and negatively than food items. Both the food and affect variables were created to encompass items which would elicit both mild and intense ratings. Very few affective items were rated neutrally. Some examples are *Cleaning Your House* (4.6), *Gardening* (0.1), *Looking down from a Great Height* (-4.7), and *Speaking in Front of an Audience* (-9.5). However, it is debatable if these items received a fairly neutral rating because participants had only a mild liking or disliking for them or if participants formed two dichotomous groups. Perhaps many participants rated an item quite high or low, while only a few gave an item a truly neutral rating. This disparity in ratings could at first glance lead to the conclusion that an item is neutral to participants when in fact it is either highly liked or highly disliked.

Overall, most of the affective items elicited intense responses. Conversely, the food items were rated much more mildly. Only seven food items were rated negatively, and the mean rating for the most negative food item was only -10.9 (*Black Coffee*). In fact, 52% of foods were rated from 15 to -15, while only 7% of affective items were rated in the same range. Thus, affective items in general elicit a more intense liking or disliking than do foods.

Mean Analysis and ANOVA of "Foodie" and "Nonfoodie" Groups

Eating Your Favorite Food is a variable which is of special interest in psychophysics and food science. *Eating Your Favorite Food* had a mean rating of 61.4, which was higher than the mean ratings for any of the specific food items. In this study, a Foodie was defined as a participant whose liking for *Eating Your Favorite Food* versus *The Most Joy You Have Ever Felt* was higher than the median. *The Most Joy You've Ever Felt* was used for comparison because it was the highest rated variable in the dataset. Foodie analysis was performed using the following calculation:

(*Eating Your Favorite Food/The Most Joy You Have Ever Felt*)*100

The median of this calculation was 70.0; thus, individuals whose value was larger than 70.0 were labeled Foodies while those whose ratio was less than or equal to 70.0 were labeled Nonfoodies. Because *The Most Joy You've Ever Felt* was the highest rated variable, it was thought individuals who were above the median when *Eating Your Favorite Food* was compared to it had a stronger affective relationship with food than did those who fell at or below the median. There were 161 Foodies and 167 Nonfoodies in this dataset. Table 4-4 shows the mean ratings of the groups for Foodies and Nonfoodies, as well as the significance from an ANOVA calculation.

Foodies and Nonfoodies showed significantly different means for their ratings of every group with the exception of Alcohol. For positive groups, the Foodie mean group rating was significantly higher than the Nonfoodie rating. For negative groups, the Foodie mean group rating was significantly lower than the Nonfoodie rating. All differences found were significant at p-value of <.01. Thus, Foodies have a stronger liking for foods than do Nonfoodies, and Foodies rate affective items more intensely than do Nonfoodies. Thus, individuals who get greater pleasure from food were

concluded to be more affectively reactive than their counterparts who receive less pleasure from food. Foodies feel greater pleasure from positive affective experiences and greater displeasure from negative affective experiences than do Nonfoodies.

Correlations Using Groups: Smell Related Affective Items

The questionnaire contained three affective items related to smell: *The Worst Thing You've Ever Smelled, Smelling Your Favorite Meal*, and *Smelling Your Favorite Flower*. Table 4-5 shows the Pierson Product Moment Correlation Coefficient, or R-Value of each item when it is correlated with the 11 groups detailed previously. From henceforth, the Pierson Product Moment Correlation Coefficient will be referred to as the CC. A positive CC indicates most participants rate an item positively or negatively using the HgLMS, and then rate a group in the same direction. For example, *The Worst Thing You've Ever Smelled* correlates positively with the Anger/Anxiety group. Most participants rated both *The Worst Thing You've Ever Smelled* and the variables in the amalgamative group Anger/Anxiety negatively (averaging -58.0 and -46.4, respectively) using the HgLMS. Since both items were rated in the same direction (negative), the correlation is positive. If two items are rated in opposite directions (one is rated positively and one is rated negatively), the CC will be negative. This is the case with the item *Smelling Your Favorite Meal* and the Disgust/Fear group. Most participants rated *Smelling Your Favorite Meal* positively and variables in the amalgamative Disgust/Fear group negatively, so the correlation is negative.

In this dataset, a CC from 1.0 to .142 or -1.0 to -.142 was significant at a p-value of <.01. Nearly all of the variables were highly significant, with many having a p-value of <.001. The exception is Alcohol. This group did not correlate significantly with any of the smell items. These low correlations may be caused by the demographics of the

participants. The mean age of all participants was 21.5, with the median being 20. The spread on the Alcohol group was larger than the other groups, possibly because some young participants find the often strong and bitter taste of alcohol displeasing and rate it negatively, while others may enjoy the taste of alcohol and rate it positively. Some individuals may rate alcohol positively because of its intoxicating effects rather than its taste. In this regard, some participants rated the component variables of the Alcohol group as foods, while others rated them affectively. This could account for the wide spread of data in the Alcohol group, which did not correlate highly with any of the smell items.

Aside from Alcohol, the correlation between the other groups and each of the three smell items was highly significant (p-value <.001). Each of the variables was a component of an amalgamative group. *Smelling Your Favorite Meal* and *Smelling Your Favorite Flower* are components of the Sensory Pleasure group, while *The Worst Thing You've Ever Smelled* is a component of the Disgust/Fear group. To keep these items from correlating with themselves and thus artificially inflating the CC, each variable was taken out of its respective group during the analysis.

The Worst Thing You've Ever Smelled

For *The Worst Thing You've Ever Smelled*, Sensory Pleasure was the group with the highest CC (-.541). As all of the Sensory Pleasure items relate to positive feelings involving smell, touch, sight, sound, and taste, it makes sense that this group would have a highly negative correlation with *The Worst Thing You've Ever Smelled*. Individuals who place an emphasis on sensory experiences in their lives would find *The Worst Thing You've Ever Smelled* more displeasing than those who do not value sensory experiences as highly. As *The Worst Thing You've Ever Smelled* had a

moderate-high mean negative rating (-58.0), it is clear that “good” groups such as Sweet, Amusement/Excitement, and Satisfaction/Contentment should have a negative CC while “bad” groups such as Anger/Anxiety and Disgust/Fear should have a positive CC.

Smelling Your Favorite Meal

High CCs for *Smelling Your Favorite Meal* were Sweet (.528), Amusement/Excitement (.597), Satisfaction/Contentment (.529), and Sensory Pleasure (.636). *Smelling Your Favorite Meal* can be exciting, and these high CCs show individuals who highly value being amused and excited also value the smell of their favorite food. Food has long been a source of contentment, so the Satisfaction/Contentment group logically has a high CC. Smell is the sense most tied to memory and hedonics, so the high CC for the Sensory Pleasure group also makes sense. Sweet is a little more difficult to understand. Why would individuals who like smelling their favorite meal also highly enjoy sweet foods? The word meal implies something which is likely savory rather than sweet, yet the CC for Sweet is quite a bit larger than the CC for the High Fat Savory group (.453). Individuals who strongly favor savory, fatty foods may not value the *smell* of food as much as those who enjoy sweet foods, thus higher CCs are seen for the Sweet group. In fact, for all three smell items the Sweet CCs were larger than those of the High Fat Savory and High Fat Sweet groups by at least .075 and as much as .151. Perhaps individuals who enjoy sweets also place more emphasis on the sense of smell in general.

Smelling Your Favorite Flower

Smelling Your Favorite Flower had lower CCs than the other two smell variables. This may partially be because it had a milder participant rating compared to *The Worst*

Thing You've Ever Smelled and *Smelling Your Favorite Meal* (24.3, -58.0, and 48.8, respectively). The highest rated group was Satisfaction/Contentment (.527), closely followed by Sensory Pleasure (.524). The smell of flowers tends to be pleasant, and many individuals likely feel satisfaction when smelling them. The high positive CC (.527) shows an individual who rates *Smelling Your Favorite Flower* highly will likely rate the group of Satisfaction/Contentment items highly. The Sensory Pleasure group also had high CCs because good smells logically correlate with a category espousing pleasantness of the senses.

Correlations Using Groups: Food Related Affective Items

Eight items in the questionnaire assessed participants' liking for affective items related to food. These were *Finding a Great Restaurant, Getting Invited to Dinner with Friends, Making up a Tasty New Recipe, Going to the Grocery Store, Trying New Exotic Foods, A Disappointing Meal, Eating Your Favorite Food*, and *Eating Your Least Favorite Food*. Table 4-6 shows correlations between the individual variables and the groups, along with the CC and significance. Once again, some variables are included in the amalgamative groups, and had to be taken out of the analysis. This ensures a variable does not partially correlate with itself, artificially inflating the CC. *Finding a Great Restaurant* and *Getting Invited to Dinner with Friends* are included in the Amusement/Excitement group; *Making up a Tasty New Recipe*, *Trying New Exotic Foods*, and *Eating Your Favorite Food* are included in the Sensory Pleasure group; *Going to the Grocery Store* is included in the Satisfaction/Contentment group; and *A Disappointing Meal* and *Eating Your Least Favorite Food* are included in the Disgust/Fear group.

As with the smell related affective items, the Alcohol group was not significant for most of the food related items, with the exception of *Trying New Exotic Foods*. Individuals who enjoy eating exotic foods may also be interested in experimenting with drinking different alcohols. Perhaps trying an alcoholic beverage from a different culture along with exotic food is pleasurable for adventurous individuals. The four items in the Alcohol group are generic (*Beer, Drinking a Great Glass of Wine, Whiskey*, and *Vodka*), and could encompass a participant liking for trying new alcohols, perhaps from exotic locales. This may have caused the significant association between *Trying New Exotic Foods* and Alcohol.

Finding a Great Restaurant

Finding a Great Restaurant had high CCs with the Sensory Pleasure group (.675), as well as the Satisfaction/Contentment group (.547). The CC for Sensory Pleasure slightly exceeded the CC for Amusement/Excitement. *Finding a Great Restaurant* likely correlated well with the Sensory Pleasure group because food and eating are integral components of Sensory Pleasure. Thus, someone who values eating will likely highly value an establishment where good food is served.

Getting Invited to Dinner with Friends

Getting Invited to Dinner with Friends is highly correlated with the Satisfaction/Contentment (.527), Amusement/Excitement (.590), and Sensory Pleasure (.595) groups. The senses are often stimulated when an individual thinks about a food they will consume, leading to an imagined sensory experience. The inclusion of the term “Getting Invited” in this variable adds a social component; *Getting Invited to Dinner with Friends* is certainly amusing, and it may also create social contentment in individuals.

Making up a Tasty New Recipe

Making up a Tasty New Recipe yielded high CCs with the Amusement/Excitement (.504), Sensory Pleasure (.515), and Satisfaction/Contentment (.515) groups. Thus, a strong liking for creative cooking amused, satisfied, or created pride in participants. The high Sensory Pleasure correlation connotes a liking for the sensory components of this variable: the senses are stimulated both while the food is being prepared as well as when it is consmed.

Going to the Grocery Store

Going to the Grocery Store had lower CCs overall than the other items. Along with Alcohol, the High Fat Sweet and Health Related groups were also not significant. These results could be due to the mild response participants gave this variable, with the mean rating being 18.4. The highest CCs were with the Sensory Pleasure (.360), Satisfaction/Contentment (.354) and Amusement/Excitement (.321) groups. Thus, participants who enjoy *Going to the Grocery* store find the act moderately amusing and satisfying. The significant CC with the Sensory Pleasure group is likely due to the sensory experience of being in a grocery store, as well as participant thoughts of preparing and eating the surrounding food while grocery shopping.

Trying New Exotic Foods

The highest CC for *Trying New Exotic Foods* was for the Satisfaction/Contentment (.400) group. The moderate correlation between the Satisfaction/Contentment group and *Trying New Exotic Foods* showed liking for trying new foods is linked to liking for satisfying experiences. *Trying New Exotic Foods* was not significantly correlated with the variable Health Related, meaning how an individual

rated *Trying New Exotic Foods* could not predict their dislike for the Health Related variables, as a whole.

A Disappointing Meal

A Disappointing Meal correlated negatively with Sensory Pleasure (-.457) and Amusement/Excitement (-.442) while it correlated positively with Anger/Anxiety (.428). An individual who is disappointed by a meal may feel angry, annoyed, or frustrated by the experience. This is likely why this variable had a highly positive CC with the Anger/Anxiety group. Likewise, a person who is an avid appreciator of the sensory pleasures of food may be more affected by *A Disappointing Meal* than someone who is not. An individual who places a strong emphasis on being amused may also be more negatively affected by a meal which disappoints.

Eating Your Favorite Food and Eating Your Least Favorite Food

Eating Your Favorite Food has high positive correlations with the Amusement/Excitement (.519) and Sensory Pleasure (.533) groups. Individuals who rated eating their favorite food high also rated the items in the Amusement/Excitement group high. *Eating Your Favorite Food* can be easily associated with the items included in the Amusement/Excitement group because *Eating Your Favorite Food* is likely an exciting activity for those who greatly enjoy food. *Eating Your Favorite Food* also has a high sensory value, which explains the high CC with the Sensory Pleasure group. *Eating Your Least Favorite Food* is similar; it correlated positively with Anger/Anxiety (.474) and Disgust/Fear (.512) and negatively with Amusement/Excitement (-.460) and Sensory Pleasure (-.465).

Overall, positive food related affective items tended to correlate positively with the Amusement/Excitement, Sensory Pleasure, and Satisfaction/Contentment groups.

For most, eating is a pleasant and pleasurable activity, which is why the food related affective items had higher CCs with these groups. Negative food related affective items tended to have higher CCs with Anger/Anxiety and Disgust/Fear. It is reasonable to say the thought of eating food which disgusts (*Eating Your Least Favorite Food*) or disappoints (*A Disappointing Meal*) participants will likely additionally annoy or anger them.

Strong correlations between a group and an item show one could potentially be used as a predictor for the other. The higher the CC value is, the more an item and a group correlate, and the more effectively an item can be used to predict the general response to a group of items or vice versa.

Aside from Alcohol, the group which tended to have lower CCs than the others was Health Related. While this group was significantly correlated to every variable aside from *Trying New Exotic Foods*, the food related affective variables may not be as good of predictors for participant rating for the Health Related group as these variables are for other groups, with the exception of Alcohol.

Correlations Using Groups: Dichotomous Variables

As discussed previously, some variables were dichotomous, meaning many individuals rated a variable positively while many others rated it negatively. Two affective items and two food items were assessed dichotomously: *Being by Yourself, Speaking in Front of an Audience, Beer*, and *Dark Chocolate*. Participant responses of 1 to 100 on the HgLMS for items were grouped into a “positive” variable, while responses of -1 to -100 were grouped into a “negative” variable. Responses of zero were not included in this analysis. Table 4-7 shows how the positive and negative factions of these dichotomous variables correlated with the groups.

Being by Yourself

Being by Yourself was discussed at length previously. This variable was also chosen to be represented graphically with its positive and negative components correlated to each of the groups are seen in Figures 2 through 21. The overall mean rating for this variable was 14.3; the mean negative rating was -35.0 and the mean positive rating was 49.0. *Being By Yourself (Positive)* significantly correlated with the High Fat Sweet, Sweet, Amusement/Excitement, Satisfaction/Contentment, and Sensory Pleasure groups. All of these correlations were positive. Thus, the more individuals liked being alone, the more they also liked sweets. Those who like being alone also enjoy amusing and satisfying activities. This is interesting, because it may be thought those who give a high rating to *Being by Yourself* would not be as interested in social engagements, but many of the Amusement/Excitement and Satisfaction/Contentment variables involve enjoyment while being amongst others. Individuals who enjoy being alone rated the groups pertaining to social enjoyment highly positive. Thus, those who enjoy being alone are not necessarily asocial in nature.

Being by Yourself (Negative) did not significantly correlate with any of the groups. This is also of interest, as some may believe a disliking for being alone connotes a penchant for Anger/Anxiety. However, this is not the case with the participants in this study. It may also be assumed that individuals who rate *Being by Yourself* negatively would rate groups such as Amusement/Excitement or Satisfaction/Contentment higher because they contain highly social variables, but this was not the case in this study.

Speaking in Front of an Audience

The mean rating for *Speaking in Front of an Audience* was -9.4. *Speaking in Front of an Audience (Negative)* had a mean of -39.4 while *Speaking in Front of an Audience (Positive)* had an mean of 32.4. *Speaking in Front of an Audience (Positive)* did not significantly correlate with any of the groups. *Speaking in Front of an Audience (Negative)* significantly correlated with the Sweet, Amusement/Excitement, Anger/Anxiety, Disgust/Fear, Guilt/Shame, Health Related, and Sensory Pleasure groups. The correlations for Sweet, Amusement/Excitement, and Sensory Pleasure were negative while the correlations for Anger/Anxiety, Disgust/Fear, Guilt/Shame, and Health Related were positive.

The significant CCs for Anger/Anxiety, Disgust/Fear, and Guilt/Shame for *Speaking in Front of an Audience (Negative)* are particularly pertinent. This shows the more an individual dislikes *Speaking in Front of an Audience*, the more anxiety, fear, and shame they are likely to feel. This is especially interesting as there was no correlation for any of these variables with *Speaking in Front of an Audience (Positive)*, which means that the level of anxiety, fear, or shame individuals in this study experienced cannot be predicted from how much they enjoy *Speaking in Front of an Audience*.

Beer

Beer was the most dichotomous variable in this study. The overall mean for this variable was 0.0, while *Beer (Positive)* had a mean rating of 36.0 and *Beer (Negative)* had a mean of -49.2. *Beer (Positive)* correlated significantly with every group except Guilt/Shame. *Beer (Negative)* correlated significantly with every group except High Fat

Savory and High Fat Sweet. *Beer* was originally included in the Alcohol group, so *Beer* was removed from this group so CCs were not artificially inflated.

The Guilt/Shame group was of interest for *Beer*. That *Beer (Positive)* correlated significantly with every group except for Guilt/Shame showed liking for *Beer* has no bearing on the guilt or shame a person feels. However, the Guilt/Shame variable had the highest CC for any group (.428) other than Alcohol for *Beer (Negative)*. This strong positive correlation shows the more a person dislikes *Beer,* the more guilt and shame they feel. As mentioned previously, some individuals may have evaluated alcohols more akin to affective items than foods. Perhaps some individuals who strongly dislike beer do so for a moralistic reason rather than for taste. This may explain why disliking for *Beer* highly significantly correlated with Guilt/Shame.

Dark Chocolate

Dark Chocolate had an overall mean of 19.8 while *Dark Chocolate (Positive)* had a mean of 37.5 and *Dark Chocolate (Negative)* had a mean of -28.4. *Dark Chocolate (Positive)* correlated significantly with every group except Alcohol, while *Dark Chocolate (Negative)* only correlated significantly with Sweet; this correlation was negative. Perhaps one reason some individuals do not like *Dark Chocolate* is because it is bitter and not necessarily sweet. Thus, individuals who like Sweet more will dislike *Dark Chocolate* more. However, individuals who rated *Dark Chocolate* positively also rated the Sweet group high. *Dark Chocolate* does come in different forms, and they may taste quite different from one another. For example, *Dark Chocolate* with a high percent chocolate (70-80%) is quite bitter and not very sweet. *Dark Chocolate* from a commercial producer such as Hershey's has a lower percent chocolate and often tastes

nearly as sweet as milk chocolate. Thus, individuals may have different experiences with dark chocolate, and may rate it accordingly.

Correlations Using Variables: Eating Your Favorite Food

Eating Your Favorite Food is of interest to food scientists and psychophysicists. This variable is included in the Sensory Pleasure group and is rated highly, with a mean participant response of 61.4. In this section, individual affective variables were correlated to *Eating Your Favorite Food* to ascertain which items this variable was highly associated with. Results are shown in Table 4-8 and Figures 24-41. Surprisingly, some of the items most highly associated with *Eating Your Favorite Food* were not food related. In fact, three of the top four most highly correlated variables (*Watching Your Favorite TV Show, Watching a Really Funny Movie* and *A Full Sound Night's Sleep*) were not food related. All 18 of the variables included in this section had a CC greater than.350 or less than -.350.

Many of the variables which were also part of the amalgamative Sensory Pleasure group had high CCs with *Eating Your Favorite Food*: *Listening to Your Favorite Music, Smelling Your Favorite Meal, Making up a Tasty New Recipe, Trying New Exotic Foods*, and *Smelling Your Favorite Flower*. This makes sense, as items which correlate highly with one another should logically create a cohesive group. Two of the other variables which correlated highly to *Eating Your Favorite Food* also involved the senses but were a part of the Amusement/Excitement group: *Watching Your Favorite TV Show* and *Watching a Really Funny Movie*. Perhaps because these variables are sense related they exhibit high CCs with *Eating Your Favorite Food*. Other variables which were in the Amusement/Excitement group and correlated highly with *Eating Your Favorite Food* were *Finding a Great Restaurant*, *Going to a Fun Party*

with Friends, The Funniest Joke You've Ever Heard, The Most Enthusiastic You've Ever Been About a Hobby, Getting Invited to Dinner with Friends, and *Finding a Great Restaurant*.

All of the positive variables which correlated highly with *Eating Your Favorite Food* had mean ratings within a relatively narrow range. The highest mean variable rating was for *Accomplishing an Important Goal* (70.6) while the lowest mean variable rating was for *Making up a Tasty New Recipe* (36.7). The negative variables occupied a similar range, with the highest rated being *Eating Your Least Favorite Food* (-46.3) and the lowest rated being *The Most Disgusting Thing You've Ever Eaten* (-63.3). The mean variable rating for all of the 15 positive variables correlated with *Eating Your Favorite Food* was 54.1. The mean of the mean variable ratings for the three negative variables correlated with *Eating Your Favorite Food* was -56.0. Thus, it seems many of the variables which highly correlated with *Eating Your Favorite Food* had mean ratings in the moderate-high range on both the positive and negative sides of the HgLMS.

Table 4-1. Participant demographics.

Gender	
Male	116
Female	212
Age	
18-22	281
23-29	28
30-55	13
55+	6
Ethnic background	
Hispanic	70
Non-Hispanic	258
Race	
White or Caucasian	217
Black or African-American	30
Native American, Alaska Native, Aleutian	0
Asian/Pacific Islander	54
Other	27
Incidence of ear infection	
No	225
Yes, but not serious	68
Yes, required antibiotics more than once	22
Yes, required tubes in ears	13
Vegetarianism	
No	315
Yes	13
Smoking (more than 100 cigarettes in entire life)	
No	307
Yes	21
If yes to smoking, how much do you now smoke	
Every day	3
Some days	8
Not at all	10

Table 4-2. Affect groups with their included variables and variable mean ratings.

Affect group with cronbach alpha	Included variables	Variable mean rating
Amusement/ Excitement .822	The most joy you've ever felt	90.1
	Learning your greatest wish has come true	83.6
	Your proudest moment	81.3
	Falling in love	80.7
	The most enthusiastic you've ever been about a hobby	64.5
	Going to a fun party with friends	57.1
	The funniest joke you've ever heard	57.1
	A new baby being born into your family	54.7
	Experiencing a natural wonder	53.9
	Watching a really funny movie	50.9
	Getting invited to dinner with friends	47.0
	Going to Disney World	46.0
	Watching your favorite TV show	45.0
	Watching your favorite team win	44.3
	Making a new friend	44.2
	Finding a great restaurant	43.8
	Riding a roller coaster	37.5
	Dancing	34.6
Anger/Anxiety .705	Forgetting an old friend's name	-29.5
	Getting cut-off in traffic	-32.5
	Getting lost	-34.2
	Taking a test and not knowing how you performed	-34.2
	Not understanding what those around you are talking about	-37.6
	Not getting something you really wanted	-40.2
	Losing your keys	-41.3
	The most annoyed you've ever been	-65.6
	The end of an important, special relationship	-74.2
	The angriest you've ever been	-74.3
Disgust/Fear .768	Anticipating a test result	-23.2
	A disappointing meal	-29.0
	Gaining 5 pounds	-30.1
	Seeing a roach	-39.7
	Seeing a poisonous snake	-42.5
	Not knowing which important choice to make	-44.4
	Eating your least favorite food	-46.9
	Having a deadline which seems impossible to meet	-48.5
	Being unable to control an important aspect of your life	-53.5
	The worst thing you've ever smelled	-58.0
	The most disgusting thing you've ever eaten	-63.3

Table 4-2. Continued.

Affect group with cronbach alpha	Included variables	Variable mean rating
Guilt/Shame .832	Speeding	12.3
	Needing someone else's help	-16.3
	Saying you're going to do something which you know you're not really going to do	-27.5
	The shyest you've ever been	-35.8
	Telling a lie	-36.4
	Blurting out something you shouldn't have	-41.9
	Talking badly about a friend	-43.7
	Being disrespectful	-46.2
	Getting caught doing something you're not supposed to	-48.1
	Being made fun of by others	-51.8
	Hurting someone's feelings	-53.6
	Your most embarrassing moment	-56.2
	The most jealous you've ever been	-58.3
	Watching a community suffer through a natural disaster	-60.9
	Breaking an important promise to a loved one	-66.0
	When someone important to you hurts your feelings	-67.2
	The most ashamed you've ever felt	-70.1
	The guiltiest you've ever felt	-72.0
Health related .744	Going to the doctor	-14.4
	Going to the dentist	-18.2
	Taking medication daily	-20.7
	Finding a suspicious looking mole or spot on your body	-42.9
	Getting a dental cavity	-45.2
	Being in a minor car accident	-46.0
	Getting the flu	-50.9
	Getting bad news from your doctor	-67.2
	Being diagnosed with diabetes	-73.1
	Finding a suspicious lump in your breast or testicle	-75.6
	Being in a major car accident	-75.9
	Learning a relative has a terminal illness	-85.7
	Being diagnosed with cancer	-91.0
	Learning from your doctor that you have only a few months to live	-91.6
	The death of a loved one	-93.3

Table 4-2. Continued

Affect group with cronbach alpha	Included variables	Variable mean rating
Satisfaction/ Contentment .849	Spending time with loved ones	81.2
	Sharing an intimate moment with someone you love	80.5
	Accomplishing an important goal	70.6
	Getting a good grade	63.7
	A full, sound night's sleep	62.0
	Catching up with someone special	61.6
	Successfully solving a very difficult problem	56.6
	Graduating from high school	56.1
	Meeting a major deadline on time	54.9
	Your most intense spiritual experience	50.5
	Getting a great deal on something	49.2
	Learning a new skill	46.3
	Reading a very interesting book	45.2
	Satisfying your curiosity	45.1
	Having a reason to believe a problem is about to get better	44.9
	The most inspired you've ever been by a lecture	42.4
	Losing 5 pounds	34.5
	Creating a piece of artwork	29.1
	Meditating or praying	28.5
	Getting dressed and ready for your day	18.7
	Going to the grocery store	18.4
	Working at your job	17.9
	Cleaning your house	4.6
	Gardening	0.1
Sensory pleasure .825	Eating your favorite food	61.4
	Listening to your favorite music	58.1
	Smelling your favorite meal	48.8
	Getting/giving a hug	48.7
	Getting a massage	48.1
	Watching a beautiful sunset	44.7
	Making up a tasty, new recipe	36.7
	Trying new, exotic foods	27.2
	Smelling your favorite flower	24.3

Table 4-3. Foods groups with their included variables and variable mean rating

Food group with cronbach alpha	Included variables	Variable mean rating
High fat savory .771	Lasagna	32.9
	Spaghetti with marinara sauce	31.3
	Beef steak	29.1
	Fried food	27.8
	Peanut butter	25.3
	Cheddar cheese	23.3
	Chips	23.1
	Smoked meat	19.6
	Butter	16.1
	Ranch dressing	12.9
	Sausage	12.8
	Sour cream	9.7
	Mayonnaise	-0.8
	Bleu cheese	-6.1
High fat sweet .836	Cookies, cake, or pastries	41.7
	Ice cream	40.6
	Sweets, candy	33.7
	Milk chocolate	31.4
	Oreo cookies	28.2
Sweet .742	Orange juice	30.3
	Apples	28.9
	Fresh, ripe strawberries	26.8
	Sugar	25.6
	Bananas	25.2
	Honey	20.1
	Fruit roll-ups	18.9
	Sugar sweetened drinks	18.8
	Marshmallow	13.3
	Grape jelly	10.8
	Jello	10
Alcohol .810	Drinking a great glass of wine	15.5
	Beer	0.1
	Vodka	-1
	Whiskey	-10.8

Figure 4-1. Rating of variables with their respective means. A) Top quartile

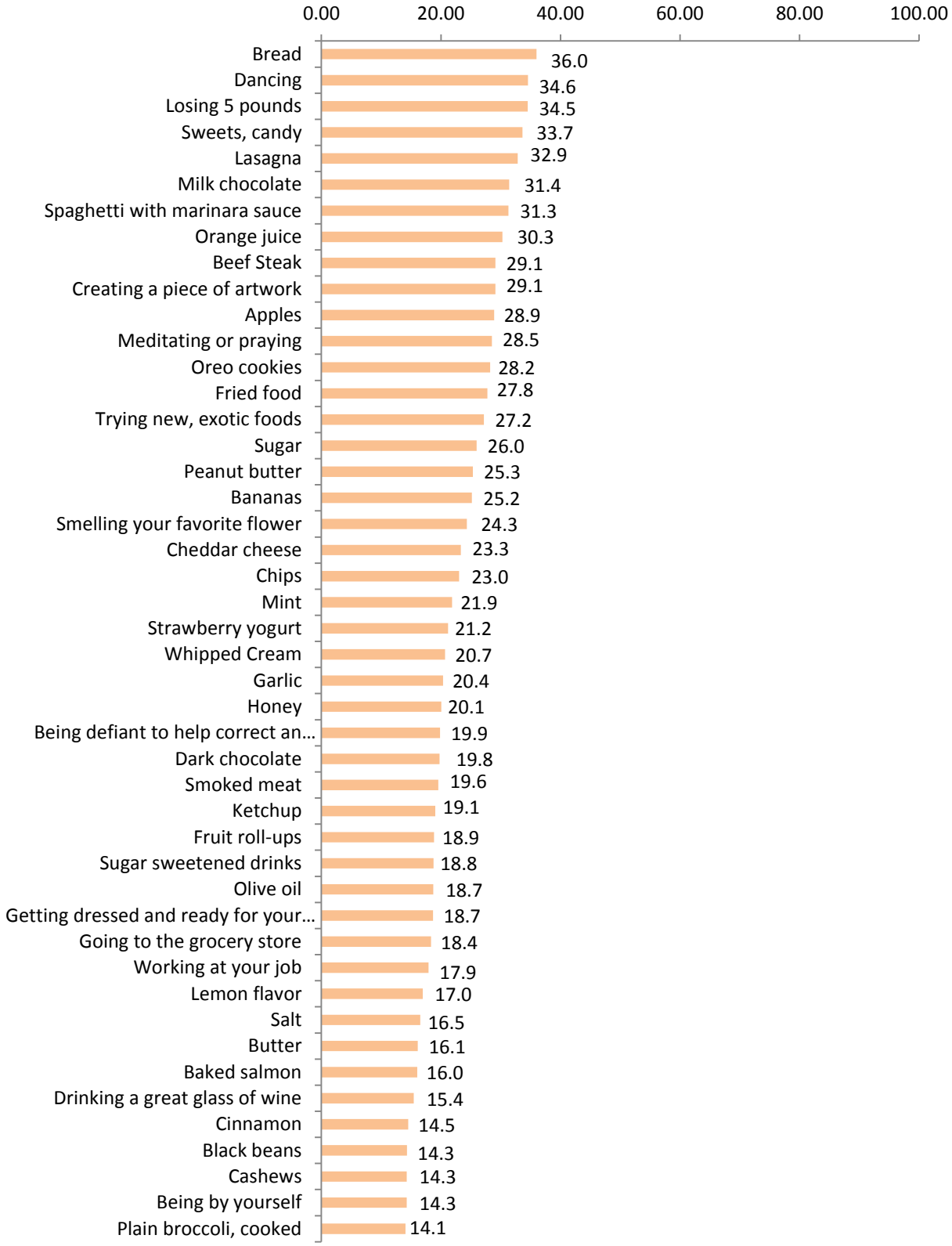

Figure 4-1. Rating of variables with their respective means. B) Second quartile

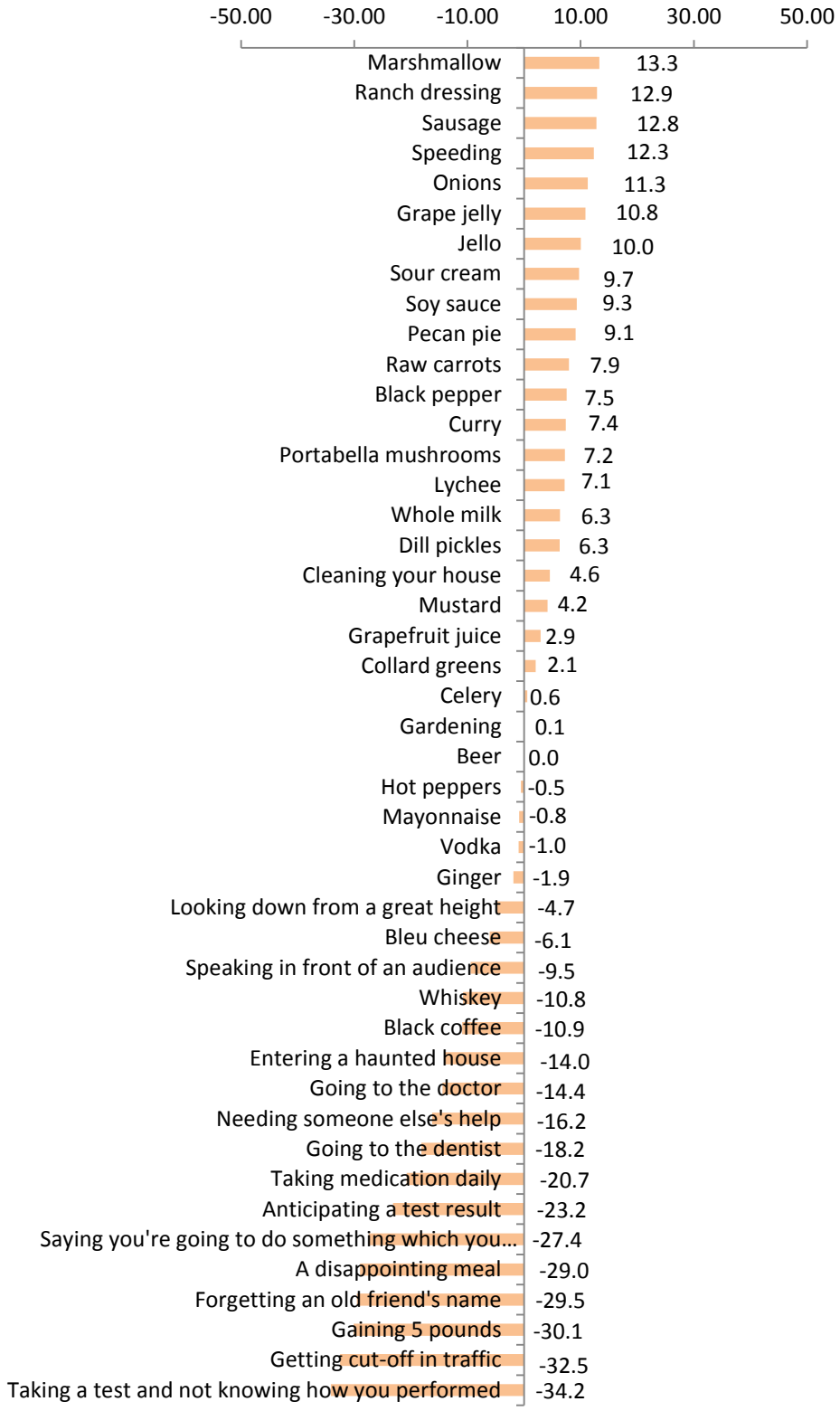

Figure 4-1. Rating of variables with their respective means. C) Third quartile

Figure 4-1. Rating of variables with their respective means. D) Bottom quartile

Table 4-4. Foodie and nonfoodie groups with their average group mean and significance.

Group	Foodie average	Nonfoodie average	Significance
High fat savory	23.7	13.2	.000
High fat sweet	42.6	27.6	.000
Sweet	27.3	16.4	.000
Alcohol	1.0	0.9	.983
Amusement/Excitement	61.5	51.8	.000
Anger/Anxiety	-51.2	-41.7	.000
Disgust/Fear	-38.4	-32.2	.000
Guilt/Shame	-50.6	-42.9	.000
Health related	-63.0	-56.0	.000
Satisfaction/Contentment	48.6	40.1	.000
Sensory pleasure	53.1	35.7	.000

Table 4-5. Smell affect variables correlated with groups

Variables	Group	Correlation coefficient	Significance
The worst thing you've ever smelled	High fat savory	-.327	.000
	High fat sweet	-.345	.000
	Sweet	-.471	.000
	Alcohol	.078	.157
	Amusement/Excitement	-.495	.000
	Anger/Anxiety	.459	.000
	Disgust/Fear	.514	.000
	Guilt/Shame	.412	.000
	Health related	.422	.000
	Satisfaction/Contentment	-.446	.000
	Sensory pleasure	-.541	.000
Smelling your favorite meal	High fat savory	.453	.000
	High fat sweet	.453	.000
	Sweet	.528	.000
	Alcohol	.009	.872
	Amusement/Excitement	.597	.000
	Anger/Anxiety	-.469	.000
	Disgust/Fear	-.413	.000
	Guilt/Shame	-.433	.000
	Health related	-.385	.000
	Satisfaction/Contentment	.529	.000
	Sensory pleasure	.636	.000
Smelling your favorite flower	High fat savory	.298	.000
	High fat sweet	.233	.000
	Sweet	.384	.000
	Alcohol	.016	.770
	Amusement/Excitement	.434	.000
	Anger/Anxiety	-.309	.000
	Disgust/Fear	-.332	.000
	Guilt/Shame	-.371	.000
	Health related	-.239	.000
	Satisfaction/Contentment	.527	.000
	Sensory pleasure	.524	.000

Table 4-6. Food related affect variables correlated to groups.

Variable	Group	Correlation coefficient	Significance
Finding a great restaurant	High fat savory	.350	.000
	High fat sweet	.362	.000
	Sweet	.390	.000
	Alcohol	.110	.047
	Amusement/Excitement	.590	.000
	Anger/Anxiety	-.423	.000
	Disgust/Fear	-.396	.000
	Guilt/Shame	-.377	.000
	Health related	-.348	.000
	Satisfaction/Contentment	.547	.000
	Sensory pleasure	.675	.000
Getting invited to dinner with friends	High fat savory	.409	.000
	High fat sweet	.387	.000
	Sweet	.461	.000
	Alcohol	-.003	.959
	Amusement/Excitement	.586	.000
	Anger/Anxiety	-.440	.000
	Disgust/Fear	-.400	.000
	Guilt/Shame	-.394	.000
	Health related	-.371	.000
	Satisfaction/Contentment	.527	.000
	Sensory pleasure	.595	.000
Making up a tasty new recipe	High fat savory	.310	.000
	High fat sweet	.212	.000
	Sweet	.338	.000
	Alcohol	.030	.587
	Amusement/Excitement	.504	.000
	Anger/Anxiety	-.286	.000
	Disgust/Fear	-.263	.000
	Guilt/Shame	-.311	.000
	Health related	-.184	.001
	Satisfaction/Contentment	.515	.000
	Sensory pleasure	.515	.000
Going to the grocery store	High fat savory	.228	.000
	High fat sweet	.120	.030
	Sweet	.285	.000
	Alcohol	-.115	.038
	Amusement/Excitement	.321	.000
	Anger/Anxiety	-.228	.000
	Disgust/Fear	-.165	.003
	Guilt/Shame	-.173	.002
	Health related	-.093	.093
	Satisfaction/Contentment	.354	.000
	Sensory pleasure	.360	.000

Table 4-6. Continued.

Variable	Group	Correlation coefficient	Significance
Trying new exotic foods	High fat savory	.227	.000
	High fat sweet	.151	.006
	Sweet	.206	.000
	Alcohol	.189	.001
	Amusement/Excitement	.312	.000
	Anger/Anxiety	-.152	.006
	Disgust/Fear	-.142	.010
	Guilt/Shame	-.209	.000
	Health related	-.052	.349
	Satisfaction/Contentment	.400	.000
	Sensory pleasure	.344	.000
A disappointing meal	High fat savory	-.280	.000
	High fat sweet	-.306	.000
	Sweet	-.356	.000
	Alcohol	.035	.525
	Amusement/Excitement	-.442	.000
	Anger/Anxiety	.428	.000
	Disgust/Fear	.394	.000
	Guilt/Shame	.329	.000
	Health related	.304	.000
	Satisfaction/Contentment	-.340	.000
	Sensory pleasure	-.457	.000
Eating your favorite food	High fat savory	.492	.000
	High fat sweet	.419	.000
	Sweet	.498	.000
	Alcohol	-.007	.901
	Amusement/Excitement	.519	.000
	Anger/Anxiety	-.435	.000
	Disgust/Fear	-.302	.000
	Guilt/Shame	-.392	.000
	Health related	-.346	.001
	Satisfaction/Contentment	.454	.000
	Sensory pleasure	.533	.000
Eating your least favorite food	High fat savory	-.277	.000
	High fat sweet	-.318	.030
	Sweet	-.325	.000
	Alcohol	-.011	.847
	Amusement/Excitement	-.460	.000
	Anger/Anxiety	.474	.000
	Disgust/Fear	.512	.000
	Guilt/Shame	.386	.000
	Health related	.391	.000
	Satisfaction/Contentment	-.377	.000
	Sensory pleasure	-.465	.000

Table 4-7. Dichotomous variables correlated to groups.

Variable	Group	Correlation coefficient	Significance
Being by yourself (positive)	High fat savory	.171	.027
	High fat sweet	.255	.001
	Sweet	.253	.001
	Alcohol	-.193	.013
	Amusement/Excitement	.333	.000
	Anger/Anxiety	-.146	.060
	Disgust/Fear	-.162	.037
	Guilt/Shame	-.153	.050
	Health related	-.182	.019
	Satisfaction/Contentment	.291	.000
	Sensory pleasure	.302	.000
Being by yourself (negative)	High fat savory	.040	.698
	High fat sweet	-.110	.285
	Sweet	-.109	.289
	Alcohol	.063	.537
	Amusement/Excitement	-.113	.193
	Anger/Anxiety	.193	.058
	Disgust/Fear	-.017	.871
	Guilt/Shame	.154	.131
	Health related	.069	.501
	Satisfaction/Contentment	.009	.926
	Sensory pleasure	.038	.715
Speaking in front of an audience (positive)	High fat savory	.045	.621
	High fat sweet	.071	.432
	Sweet	.059	.518
	Alcohol	.040	.658
	Amusement/Excitement	.176	.051
	Anger/Anxiety	-.080	.381
	Disgust/Fear	.012	.894
	Guilt/Shame	-.112	.216
	Health related	-.053	.558
	Satisfaction/Contentment	.178	.048
	Sensory pleasure	.101	.267
Speaking in front of an audience (negative)	High fat savory	-.078	.299
	High fat sweet	-.118	.114
	Sweet	-.209	.005
	Alcohol	.078	.297
	Amusement/Excitement	-.225	.002
	Anger/Anxiety	.255	.001
	Disgust/Fear	.367	.000
	Guilt/Shame	.333	.000
	Health related	.247	.001
	Satisfaction/Contentment	-.154	.039
	Sensory pleasure	-.202	.007

Table 4-7. Continued.

Variable	Group	Correlation coefficient	Significance
Beer (positive)	High fat savory	.396	.000
	High fat sweet	.267	.001
	Sweet	.316	.000
	Alcohol	.404	.000
	Amusement/Excitement	.424	.000
	Anger/Anxiety	-.359	.000
	Disgust/Fear	-.252	.001
	Guilt/Shame	-.144	.067
	Health related	-.336	.000
	Satisfaction/Contentment	.247	.001
	Sensory pleasure	.329	.000
Beer (negative)	High fat savory	-.231	.012
	High fat sweet	-.211	.022
	Sweet	-.344	.000
	Alcohol	.610	.000
	Amusement/Excitement	-.323	.000
	Anger/Anxiety	.318	.000
	Disgust/Fear	.310	.001
	Guilt/Shame	.428	.000
	Health related	.384	.000
	Satisfaction/Contentment	-.377	.000
	Sensory pleasure	-.334	.000
Dark chocolate (positive)	High fat savory	.298	.000
	High fat sweet	.354	.000
	Sweet	.367	.000
	Alcohol	-.128	.050
	Amusement/Excitement	.389	.000
	Anger/Anxiety	-.444	.000
	Disgust/Fear	-.392	.000
	Guilt/Shame	-.491	.000
	Health related	-.382	.000
	Satisfaction/Contentment	.390	.000
	Sensory pleasure	.499	.000
Dark chocolate (negative)	High fat savory	-.240	.034
	High fat Sweet	-.184	.106
	Sweet	-.344	.002
	Alcohol	.132	.251
	Amusement/Excitement	-.167	.144
	Anger/Anxiety	.126	.271
	Disgust/Fear	.212	.063
	Guilt/Shame	.119	.299
	Health related	.225	.047
	Satisfaction/Contentment	-.071	.538
	Sensory pleasure	-.245	.031

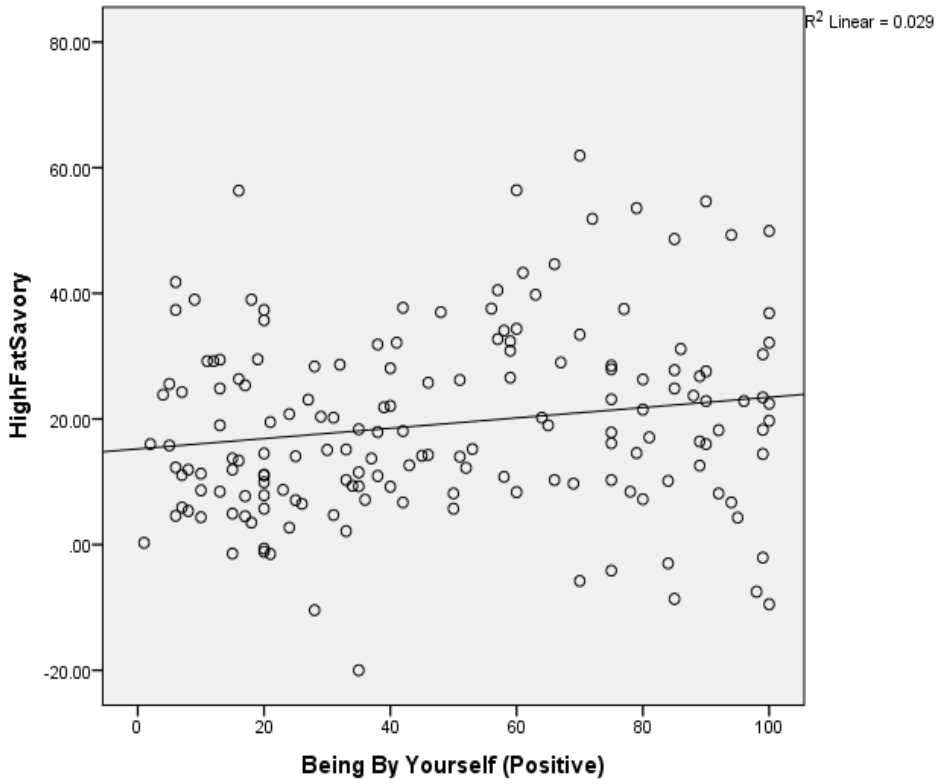

Figure 4-2. Being by yourself (positive) correlated with High fat savory

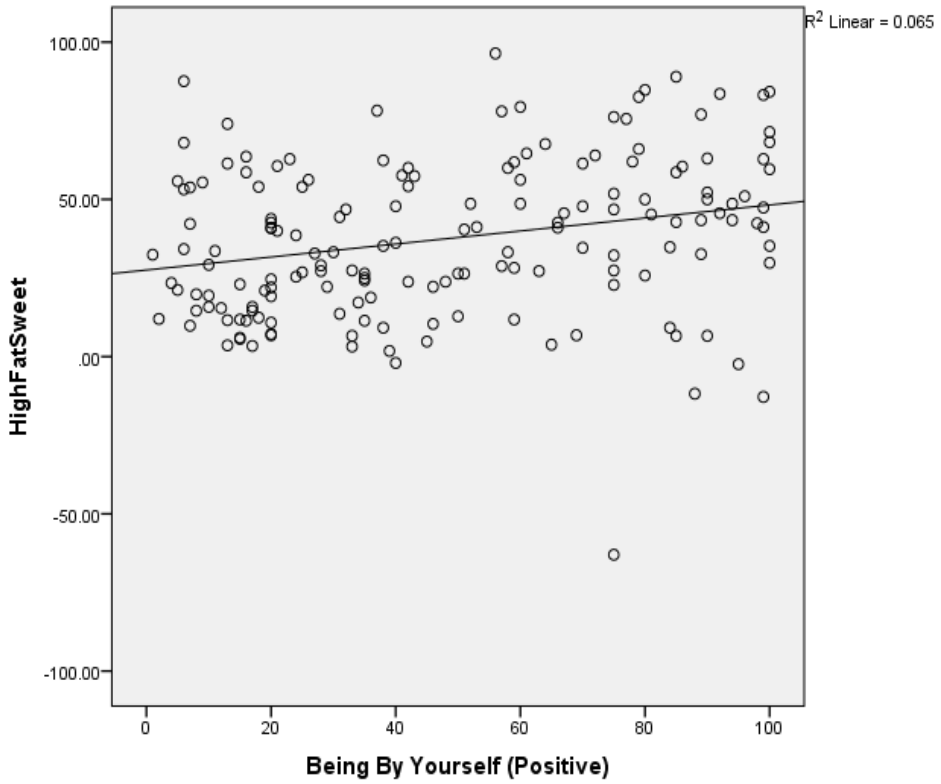

Figure 4-3. Being by yourself (positive) correlated with High fat sweet

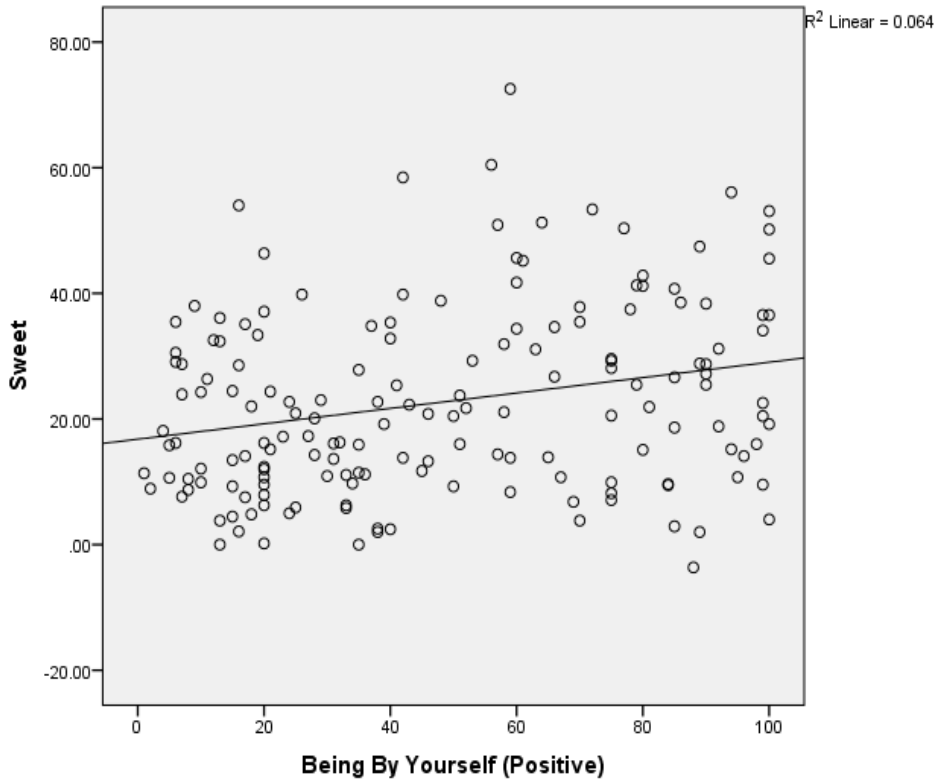

Figure 4-4. Being by yourself (positive) correlated with Sweet

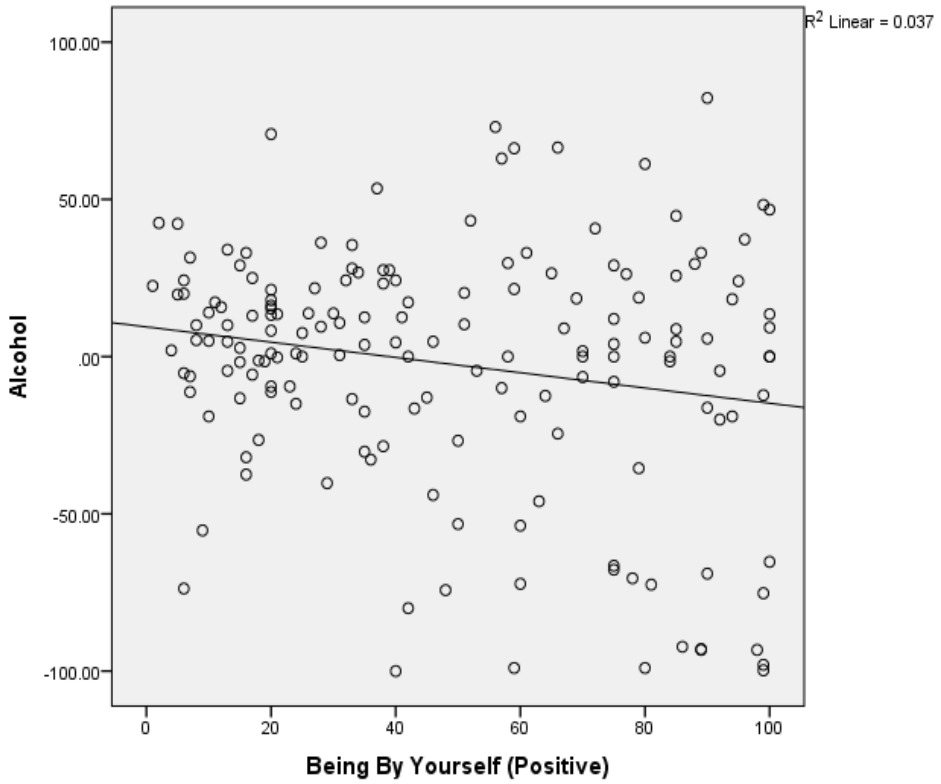

Figure 4-5. Being by yourself (positive) correlated with Alcohol

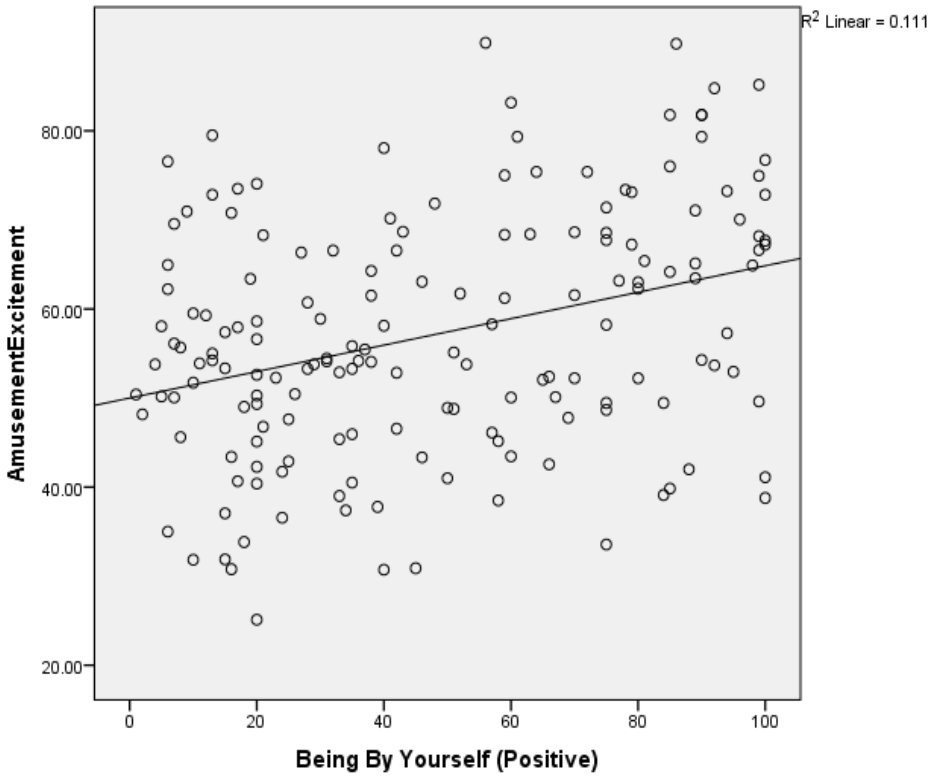

Figure 4-6. Being by yourself (positive) correlated with Amusement/Excitement

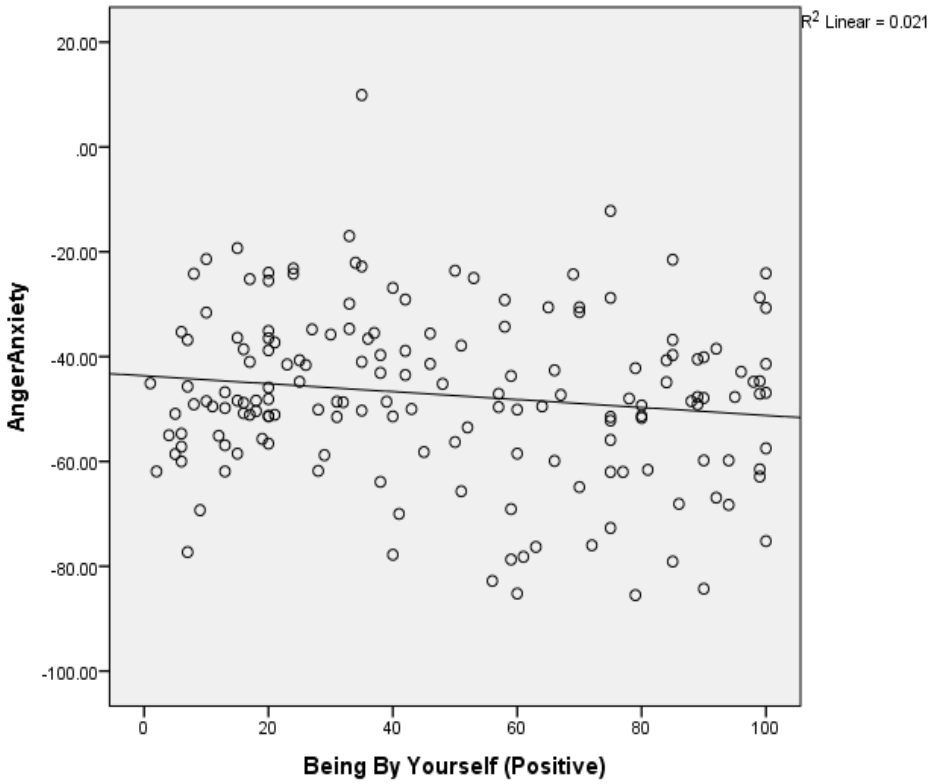

Figure 4-7. Being by yourself (positive) correlated with Anger/Anxiety

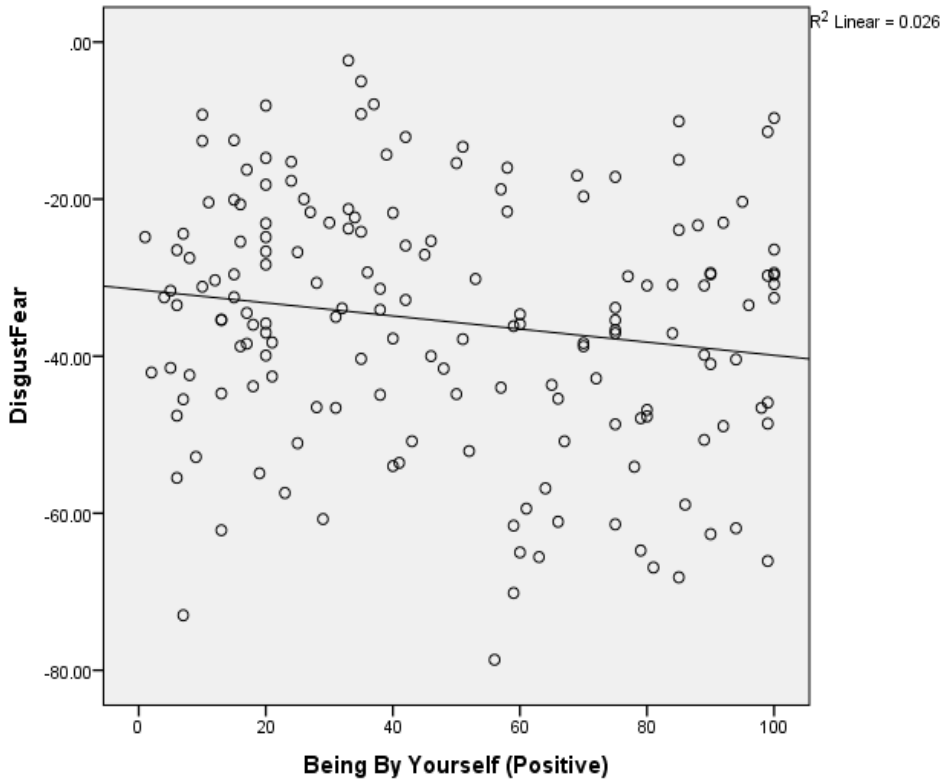

Figure 4-8. Being by yourself (positive) correlated with Disgust/Fear

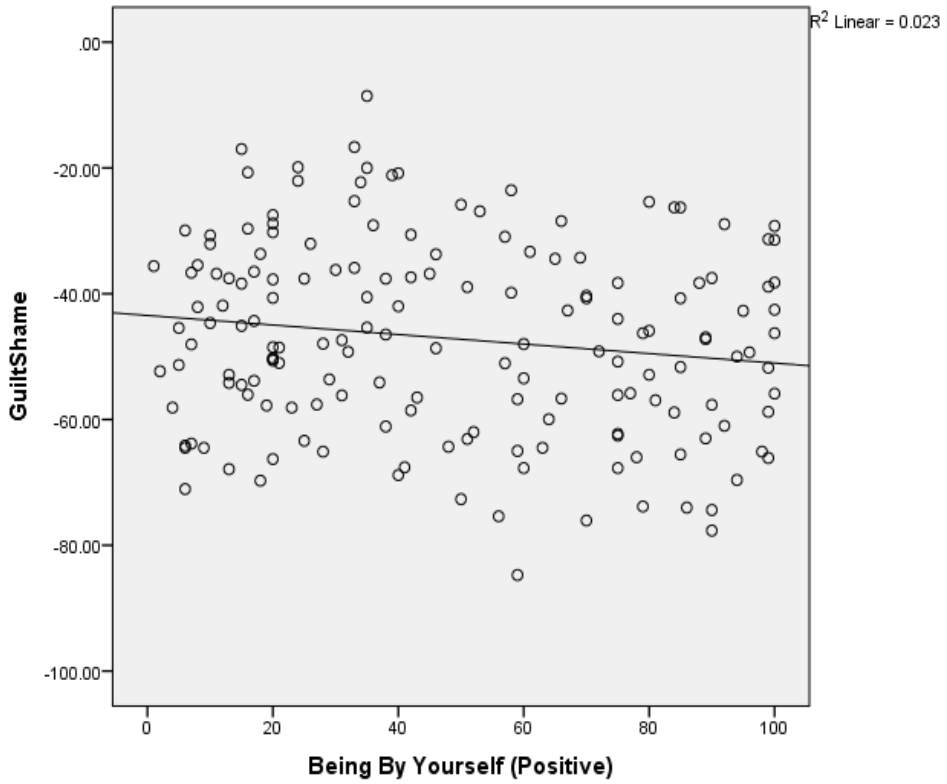

Figure 4-9. Being by yourself (positive) correlated with Guilt/Shame

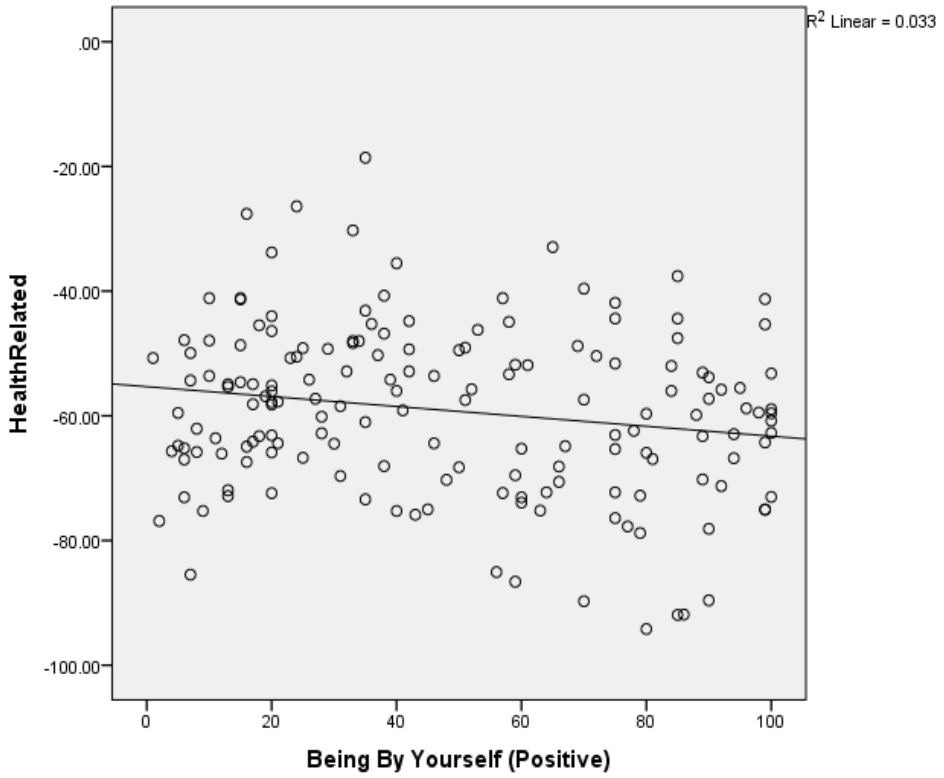

Figure 4-10. Being by yourself (positive) correlated with Health related

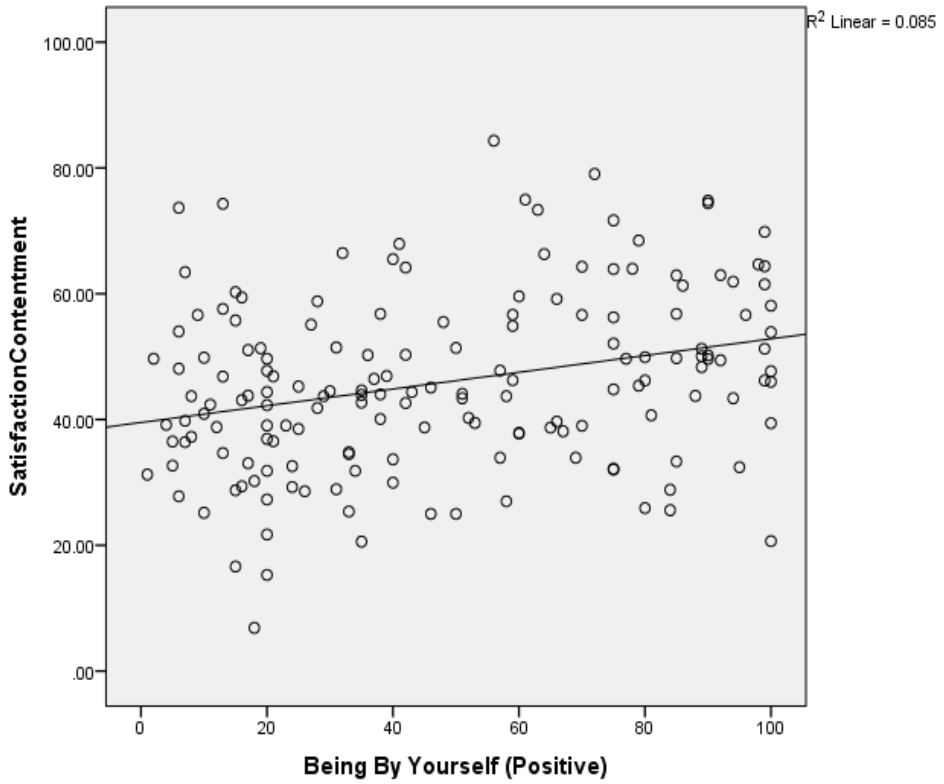

Figure 4-11. Being by yourself (positive) correlated with Satisfaction/Contentment

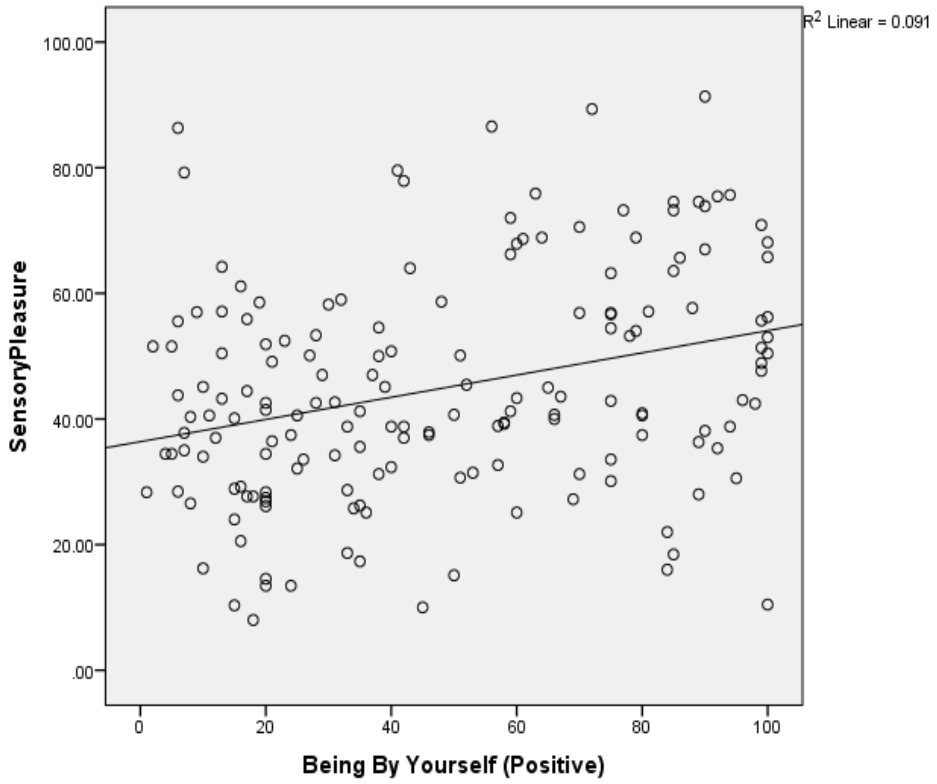

Figure 4-12. Being by yourself (positive) correlated with Sensory pleasure

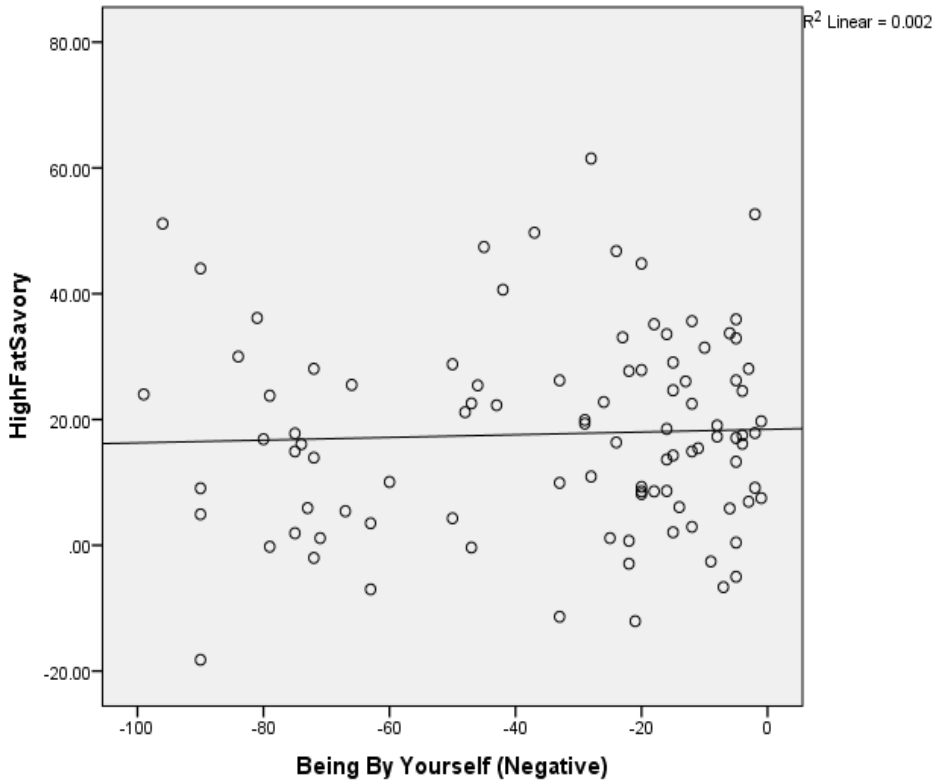

Figure 4-13. Being by yourself (negative) correlated with High fat savory

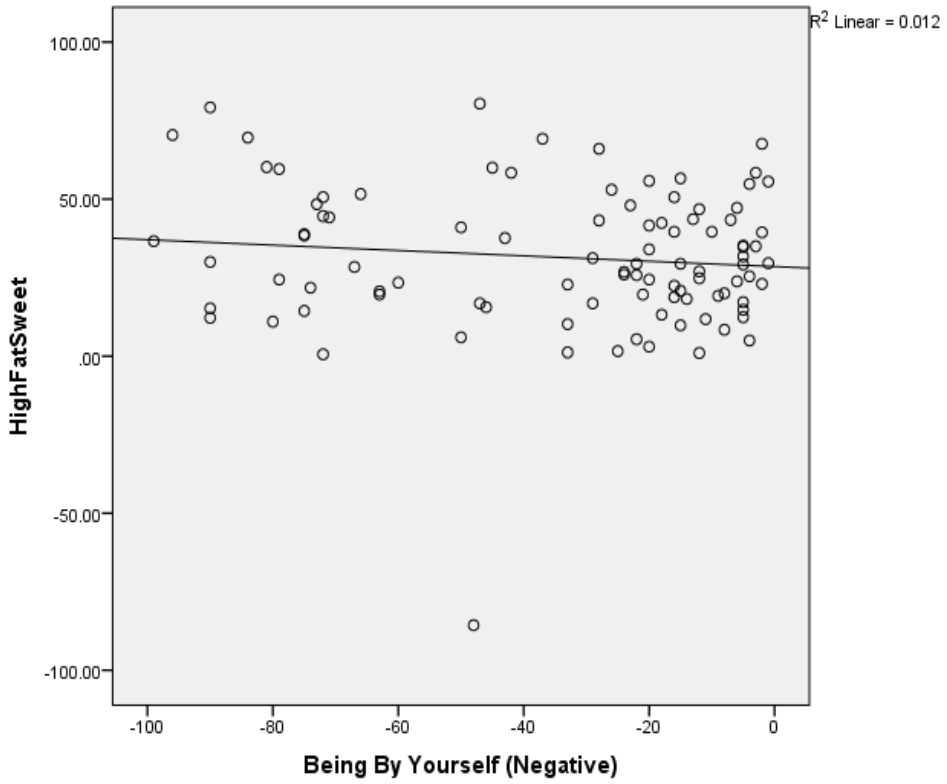

Figure 4-14. Being by yourself (negative) correlated with High fat sweet

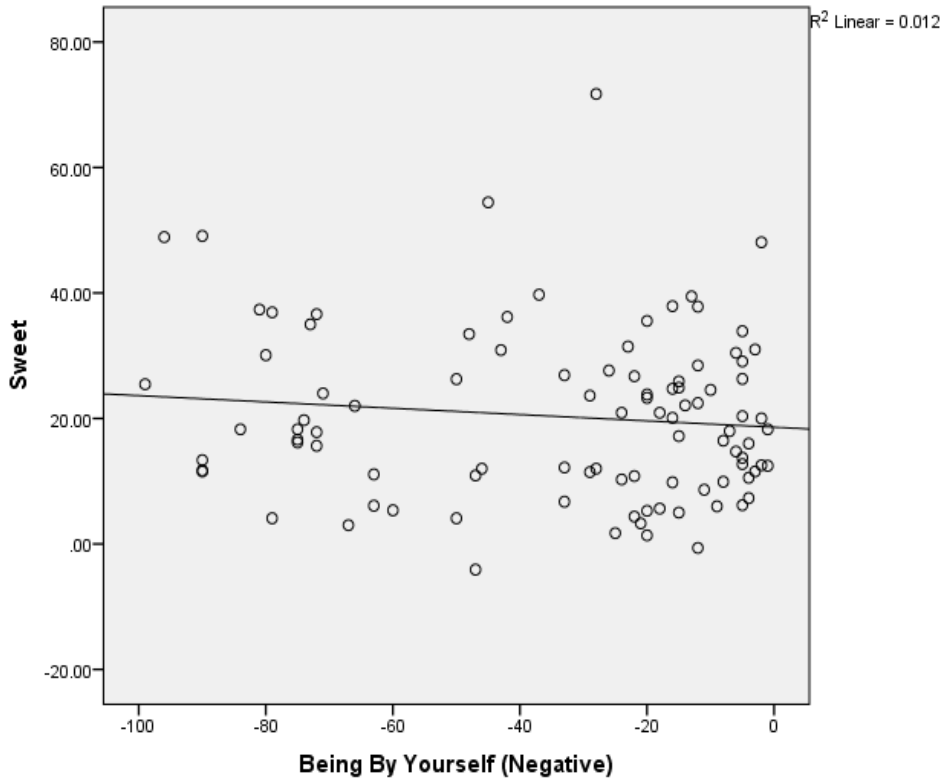

Figure 4-15. Being by yourself (negative) correlated with Sweet

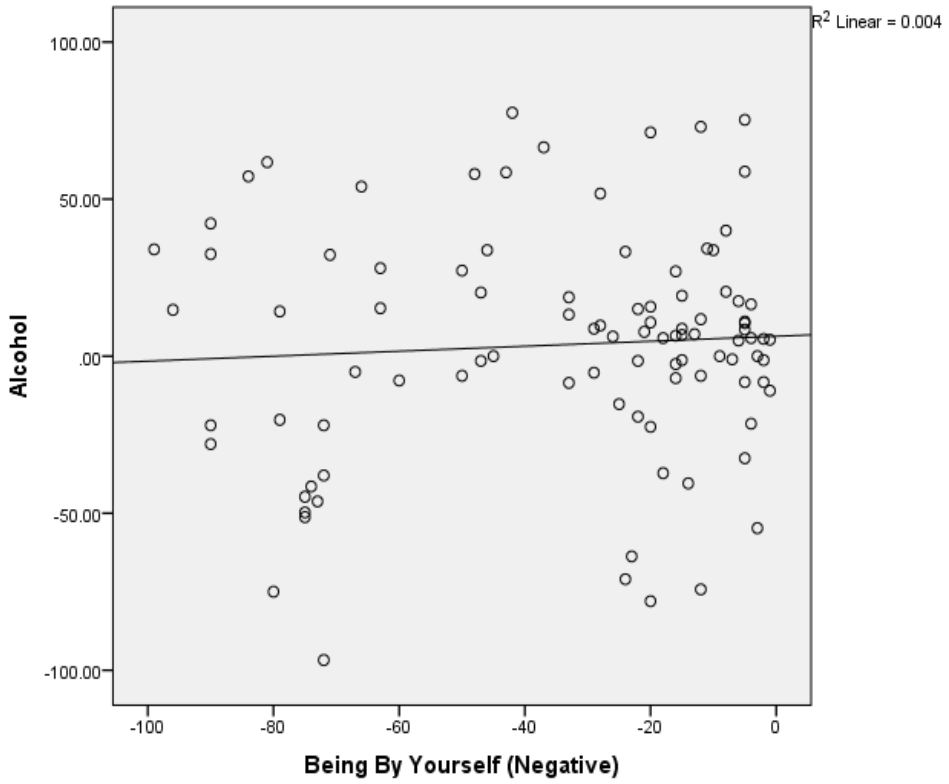

Figure 4-16. Being by yourself (negative) correlated with Alcohol

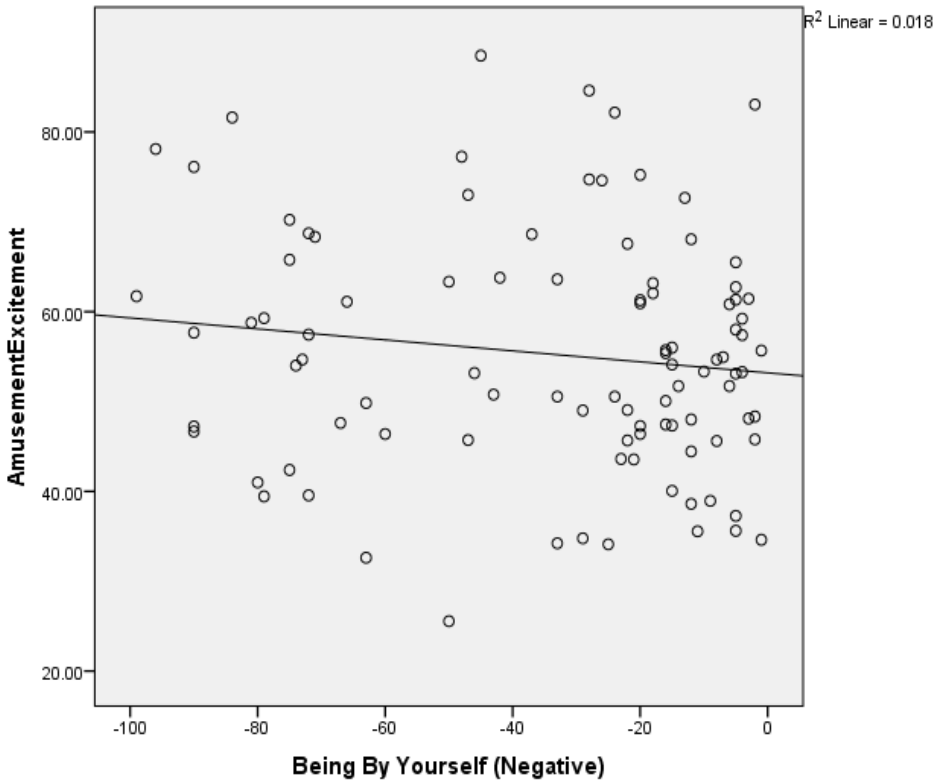

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Figure 4-17. Being by yourself (negative) correlated with Amusement/Excitement

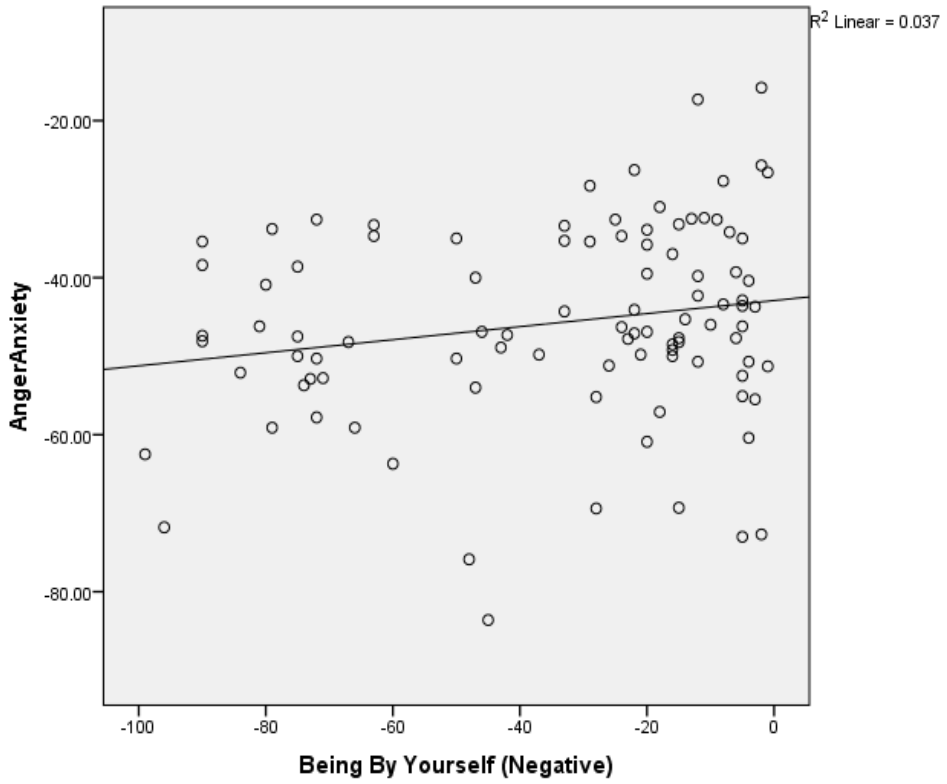

Figure 4-18. Being by yourself (negative) correlated with Anger/Anxiety

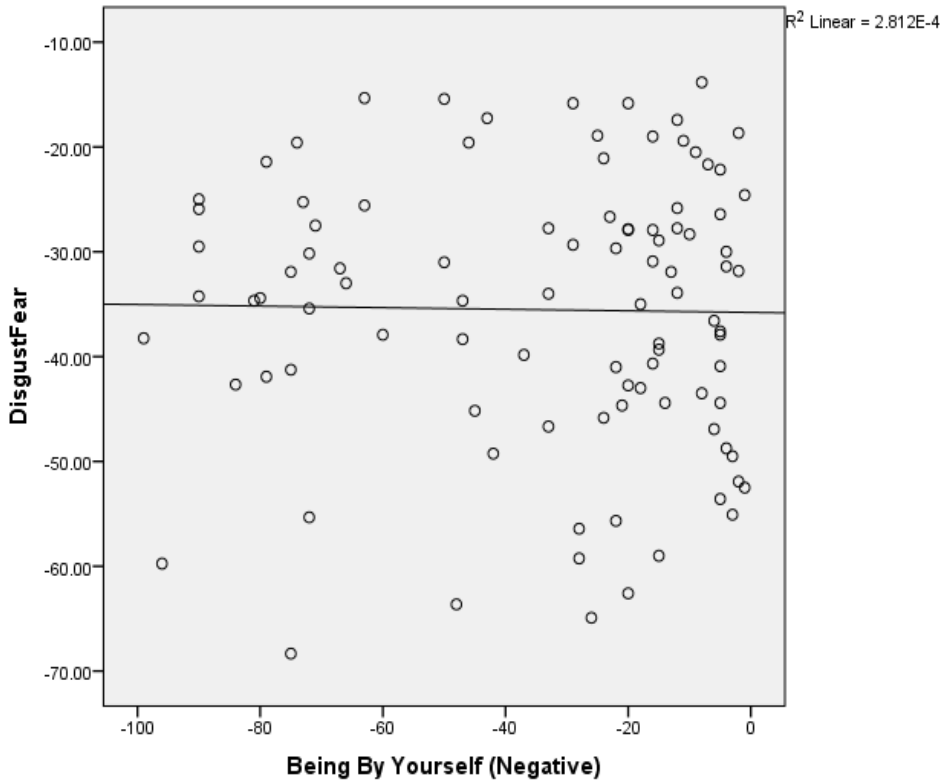

Figure 4-19. Being by yourself (negative) correlated with Disgust/Fear

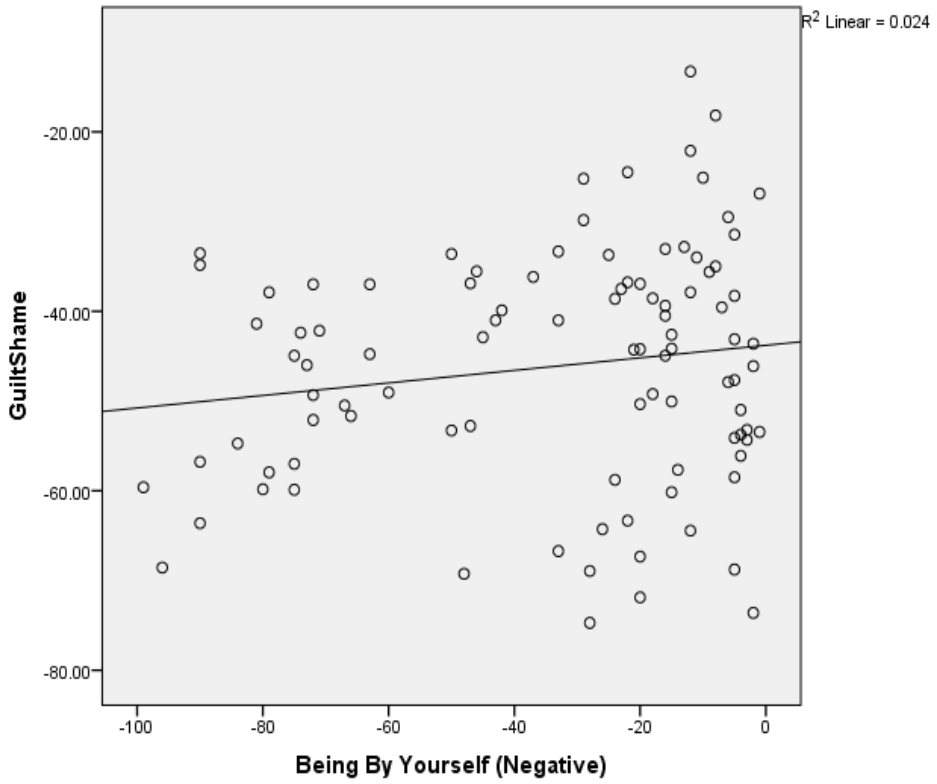

Figure 4-20. Being by yourself (negative) correlated with Guilt/Shame

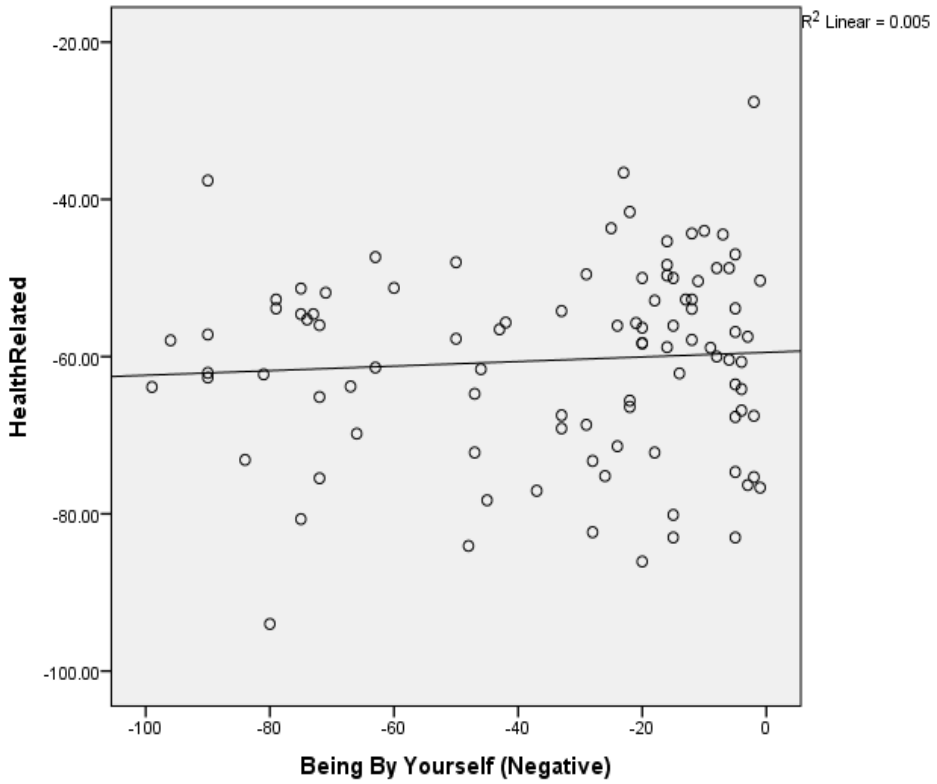

Figure 4-21. Being by yourself (negative) correlated with Health related.

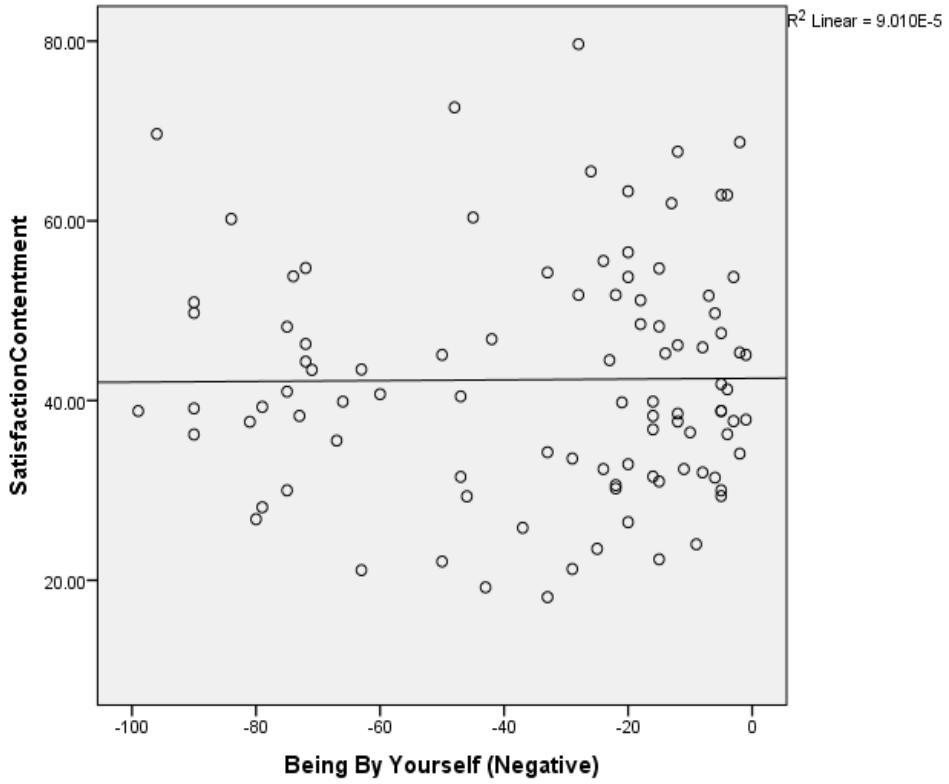

Figure 4-22. Being by yourself (negative) correlated with Satisfaction/Contentment

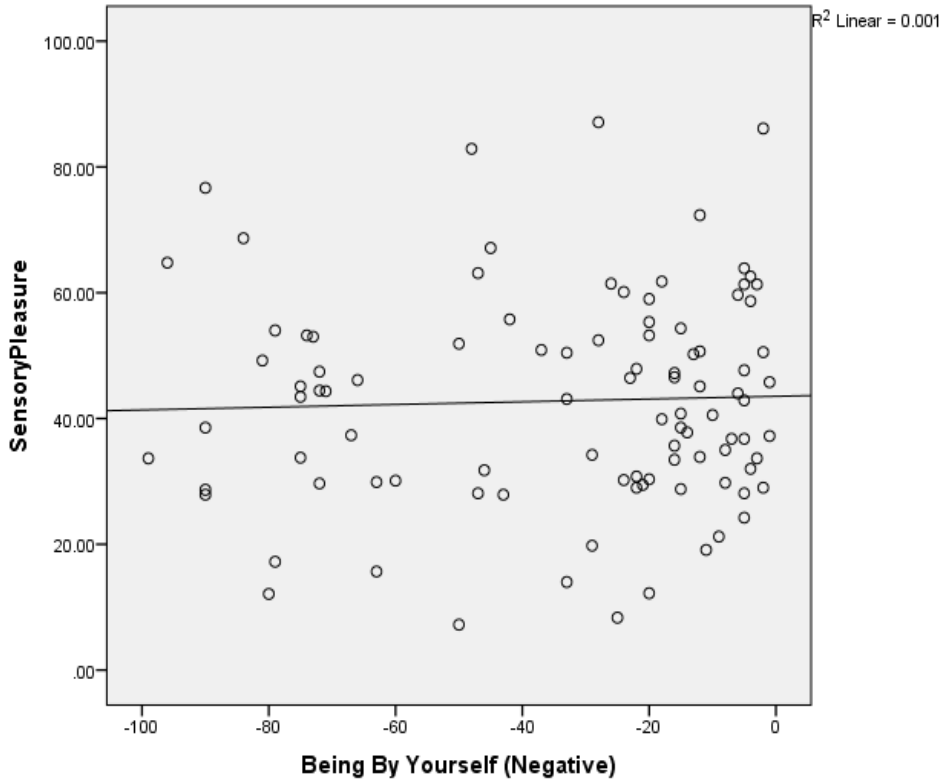

Figure 4-23. Being by yourself (negative) correlated with Sensory pleasure

Table 4-8. Correlating eating your favorite food with groups.

Variable	Item	Item mean rating	Correlation coefficient	Significance
Eating your favorite food	Watching your favorite TV show	45.0	0.577	.000
	Smelling your favorite meal	48.8	0.575	.000
	Watching a really funny movie	50.9	0.549	.000
	A full sound night's sleep	62.0	0.509	.000
	Finding a great restaurant	43.8	0.507	.000
	Getting a good grade	63.7	0.488	.000
	Listening to your favorite music	58.1	0.481	.000
	Getting a great deal on something	49.2	0.468	.000
	Getting invited to dinner with friends	47.0	0.412	.000
	The funniest joke you've ever heard	57.1	0.409	.000
	Going to a fun party with friends	57.1	0.386	.000
	Making up a tasty new recipe	36.7	0.386	.000
	Accomplishing an important goal	70.6	0.370	.000
	Successfully solving a very difficult problem	56.6	0.369	.000
	The most enthusiastic you've ever been about a hobby	64.5	0.352	.000
	Eating your least favorite food	-46.9	-0.425	.000
	The most disgusting thing you've ever eaten	-63.3	-0.426	.000
	The worst thing you've ever smelled	-58.0	-0.446	.000

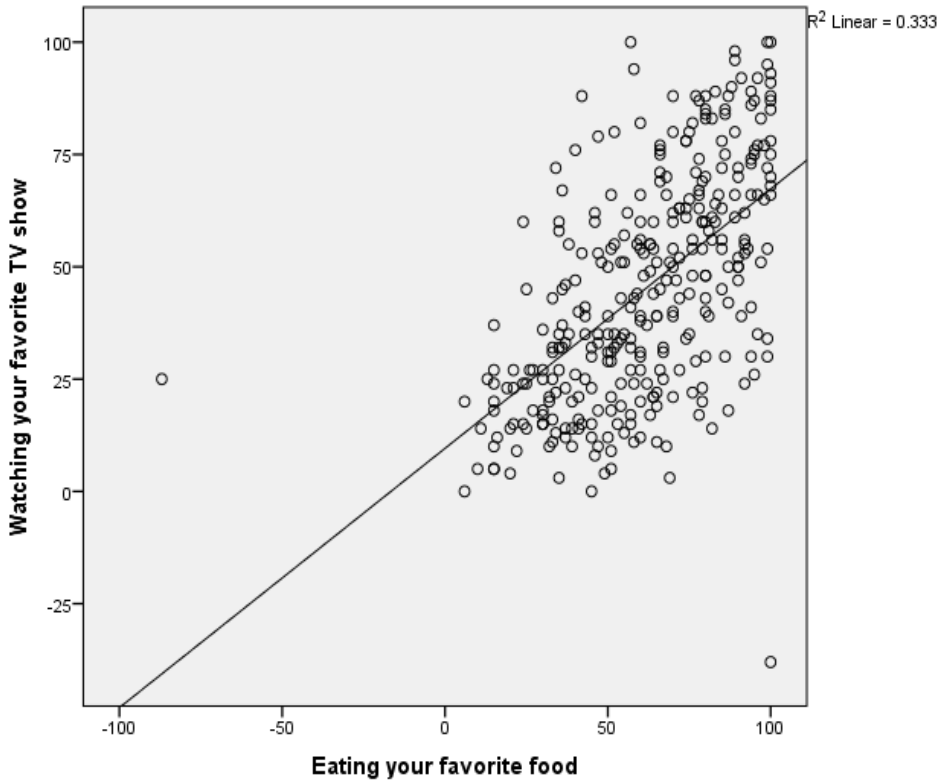

Figure 4-24. Eating your favorite food correlated with Watching your favorite TV show

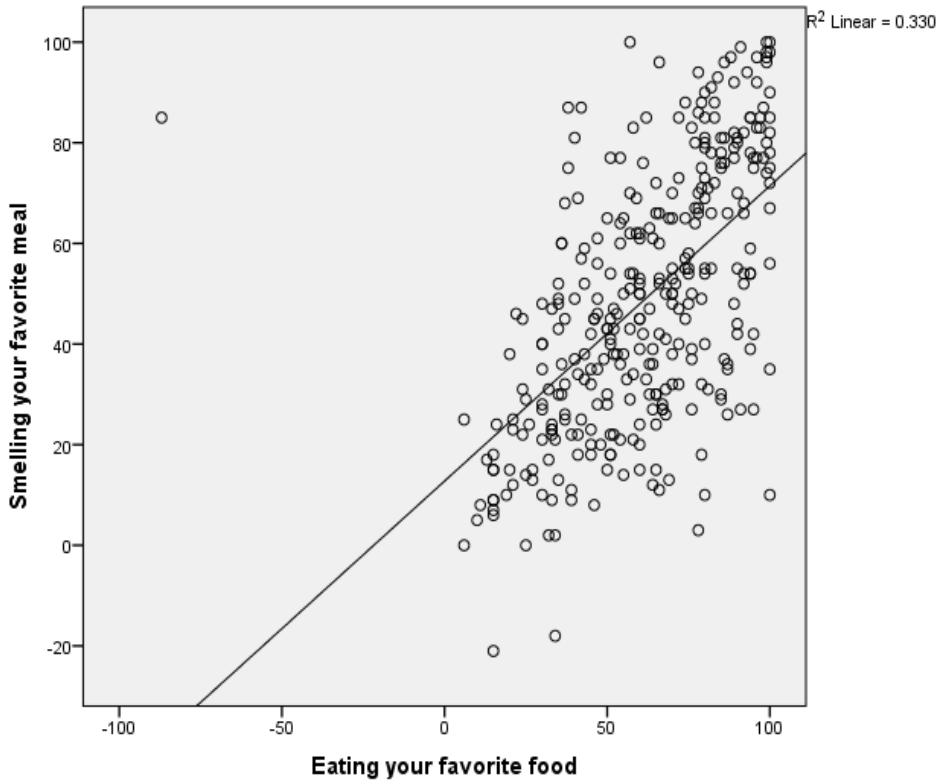

Figure 4-25. Eating your favorite food correlated with Smelling your favorite meal

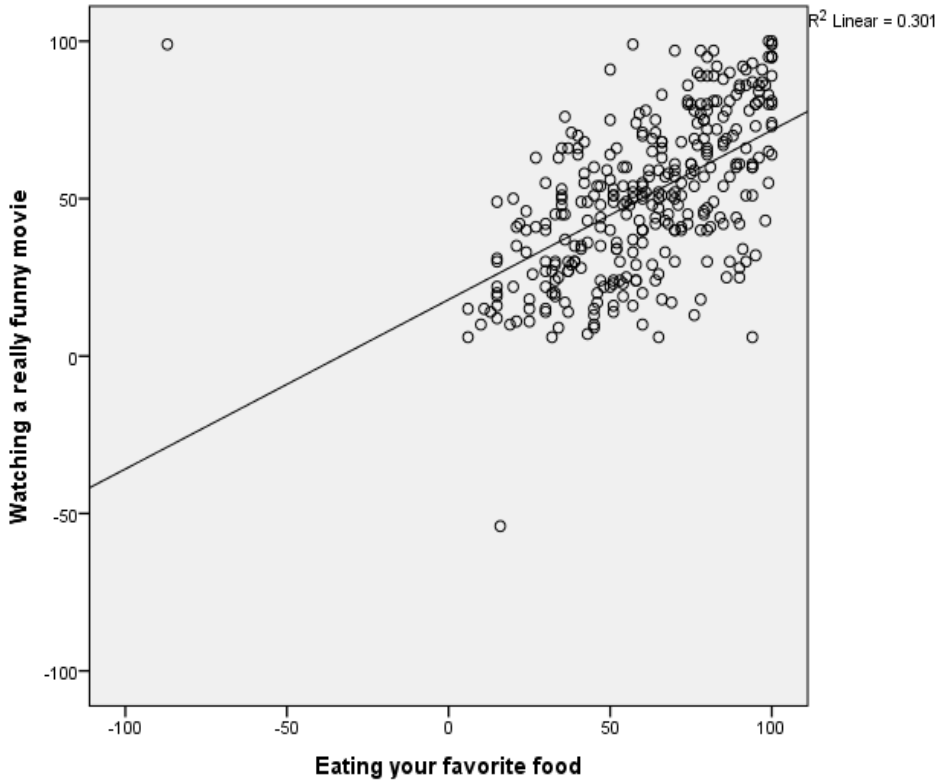

Figure 4-26. Eating your favorite food correlated with Watching a really funny movie

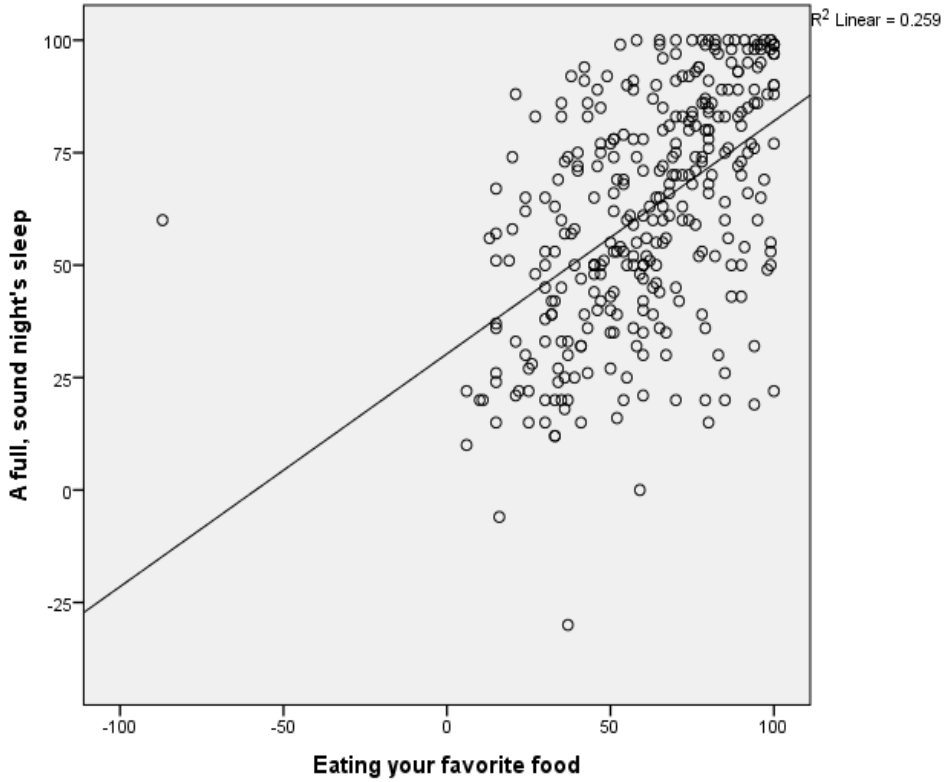

Figure 4-27. Eating your favorite food correlated with A full sound night's sleep

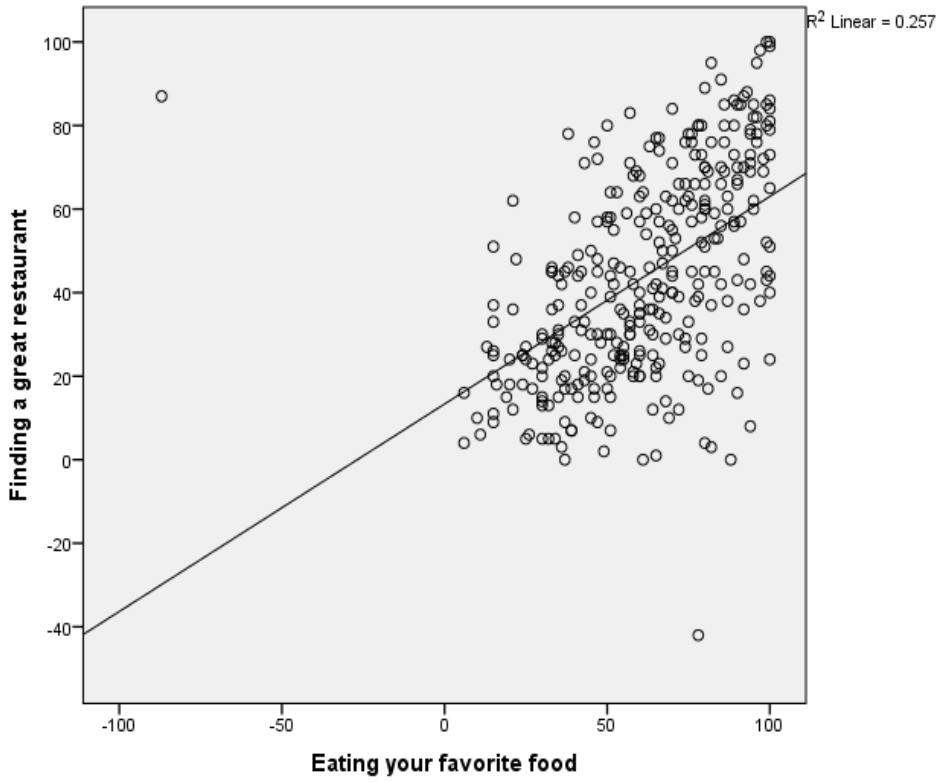

Figure 4-28. Eating your favorite food correlated with Finding a great restaurant

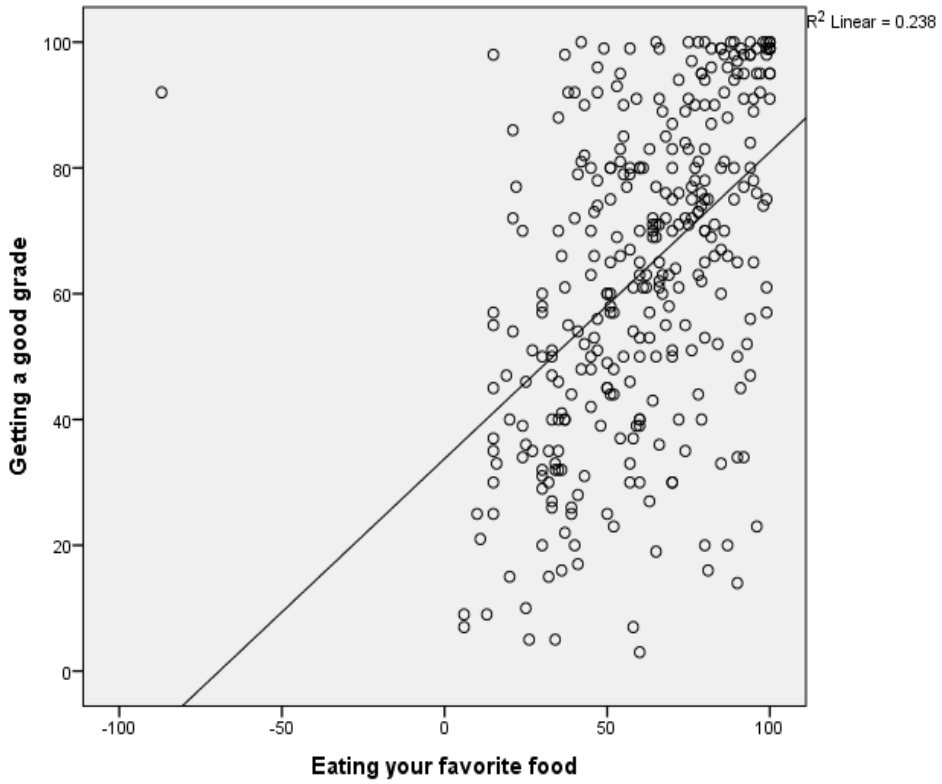

Figure 4-29. Eating your favorite food correlated with Getting a good grade

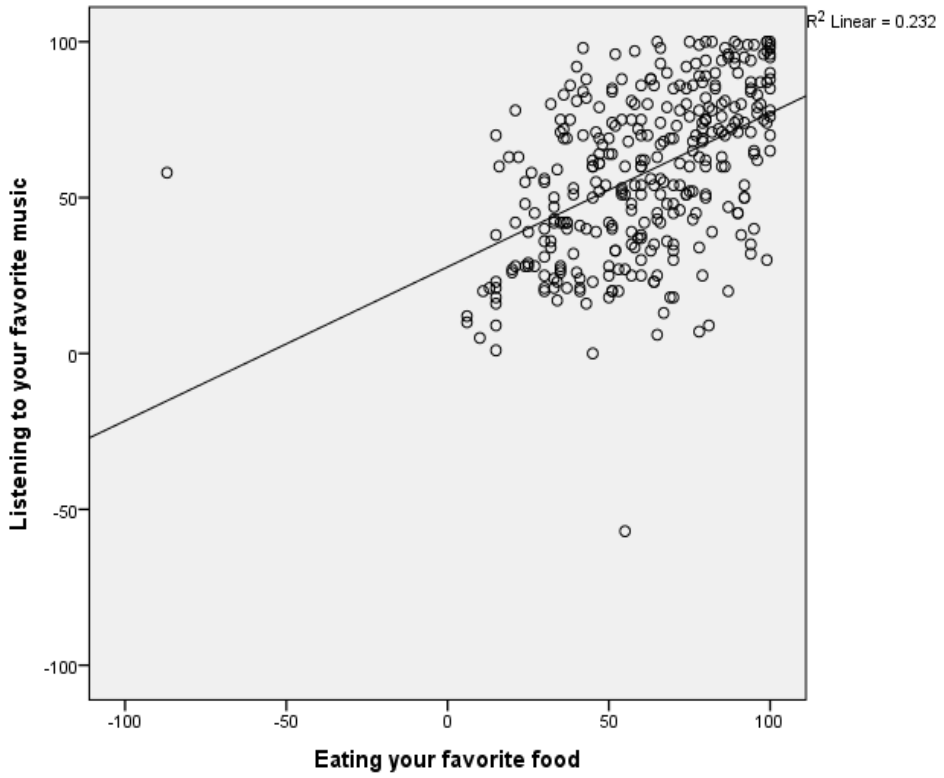

Figure 4-30. Eating your favorite food correlated with Listening to your favorite music

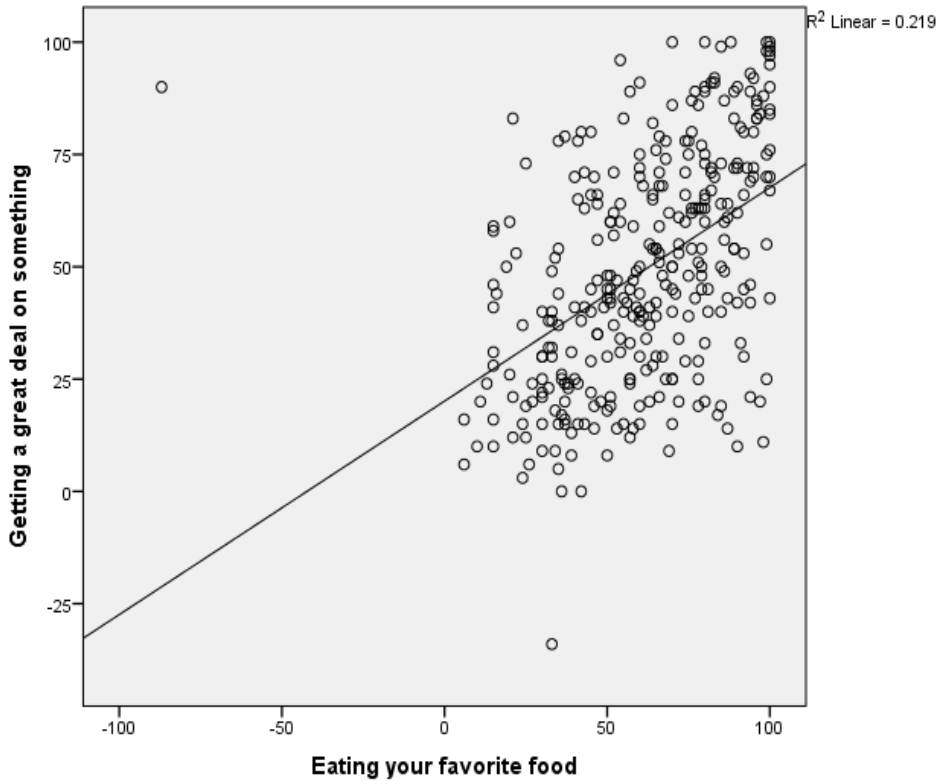

Figure 4-31. Eating your favorite food correlated with Getting a great deal on something

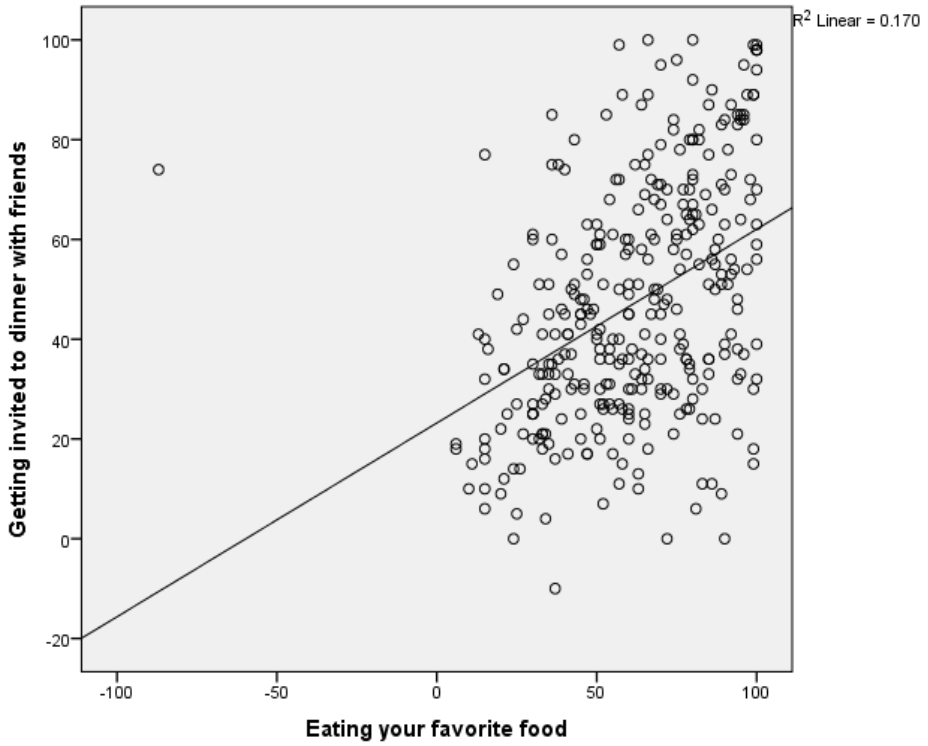

Figure 4-32. Eating your favorite food correlated with Getting invited to dinner with friends

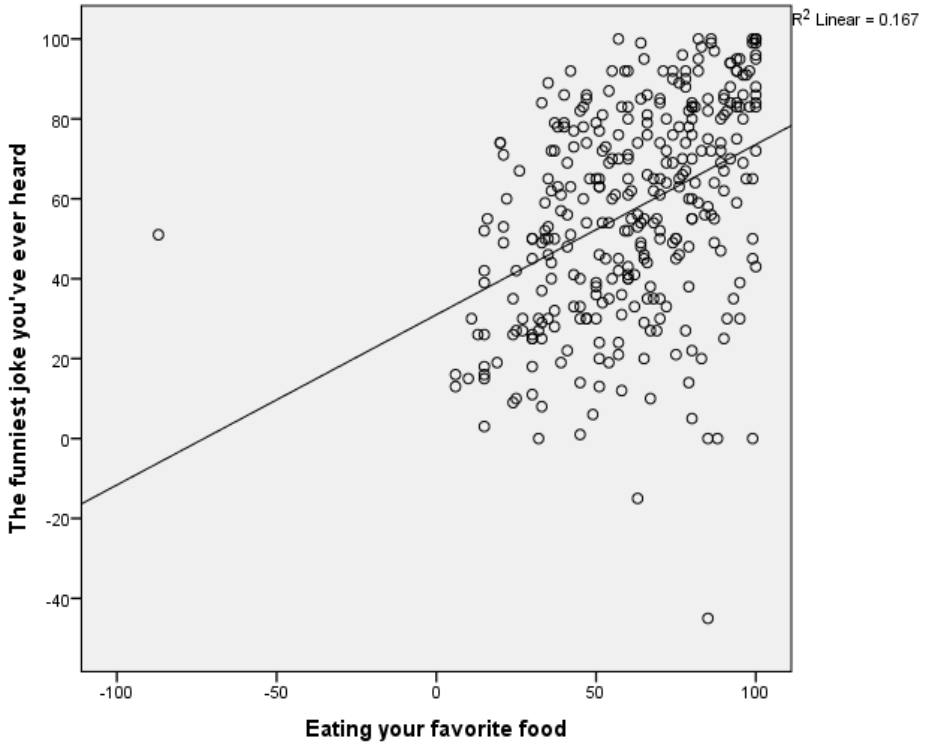

Figure 4-33. Eating your favorite food correlated with The funniest joke you've ever heard

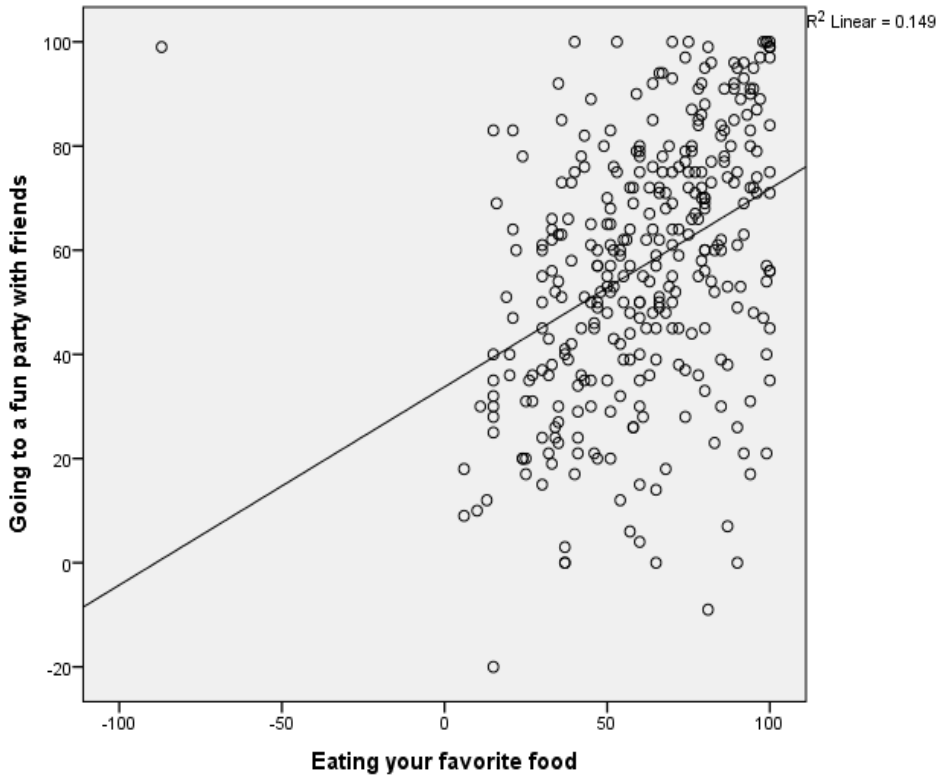

Figure 4-34. Eating your favorite food correlated with Going to a fun party with friends

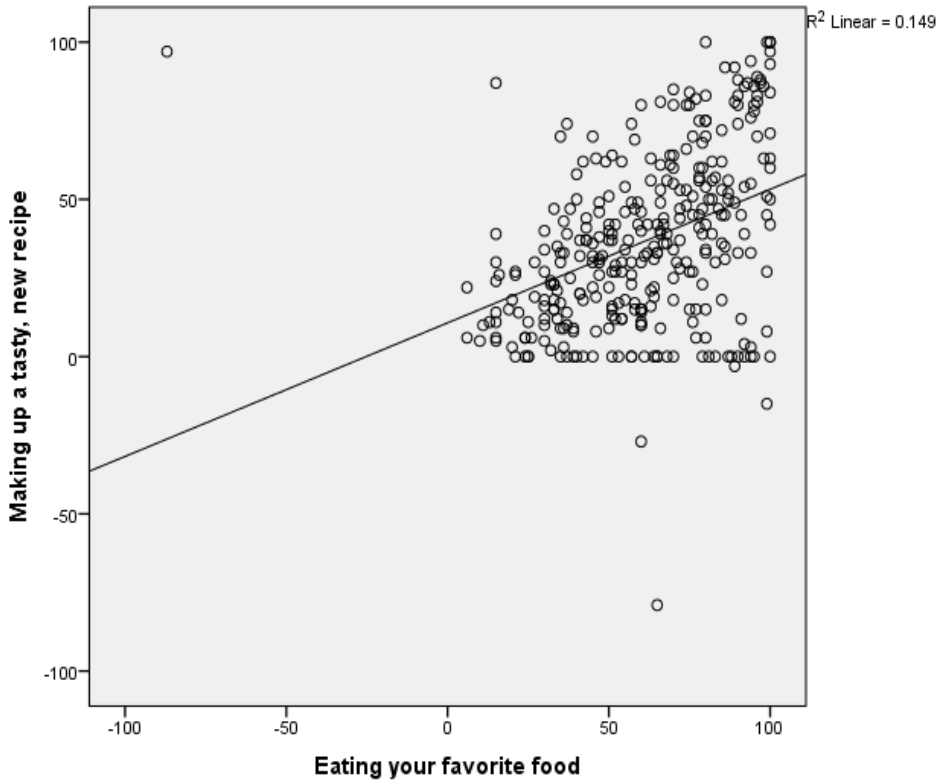

Figure 4-35. Eating your favorite food correlated with Making up a tasty new recipe

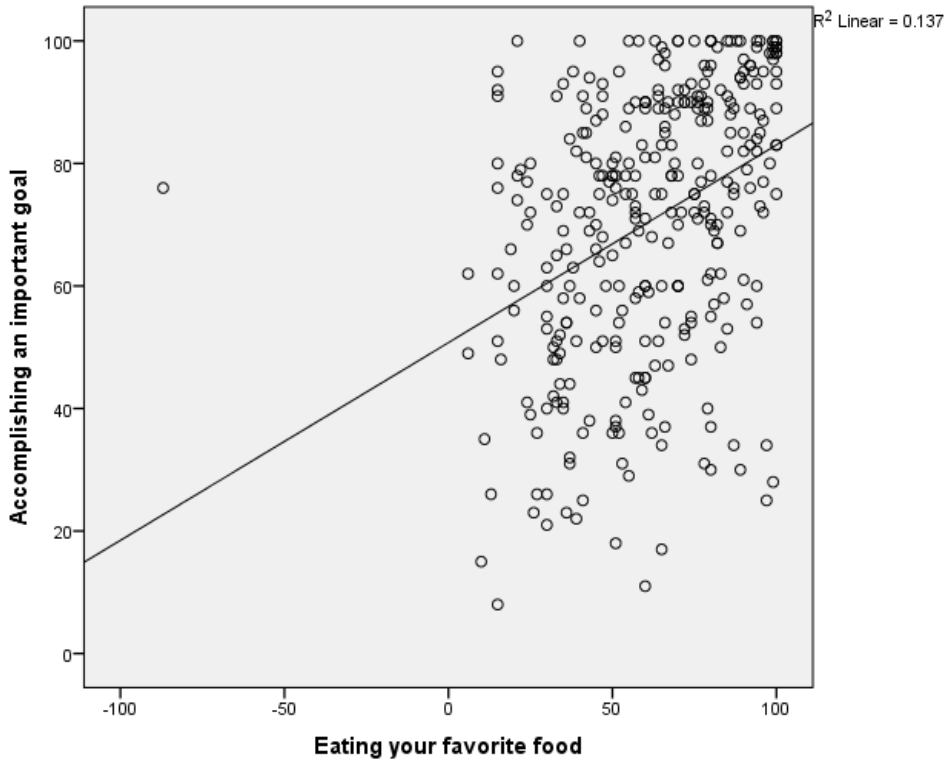

Figure 4-36. Eating your favorite food correlated with Accomplishing an important goal

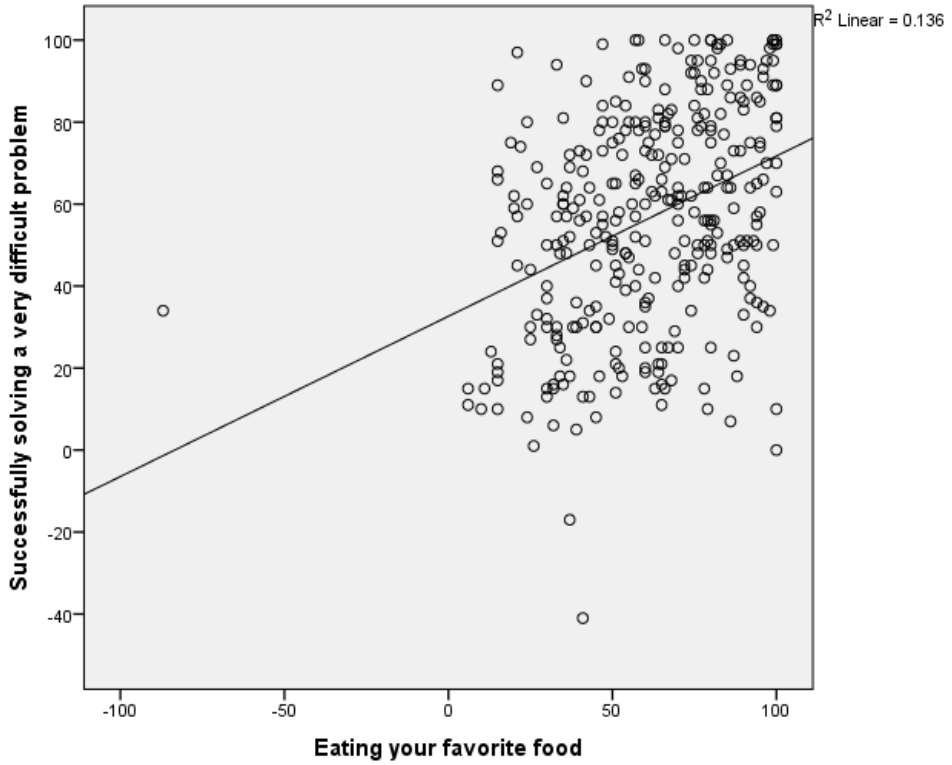

Figure 4-37. Eating your favorite food correlated with Successfully solving a very difficult problem

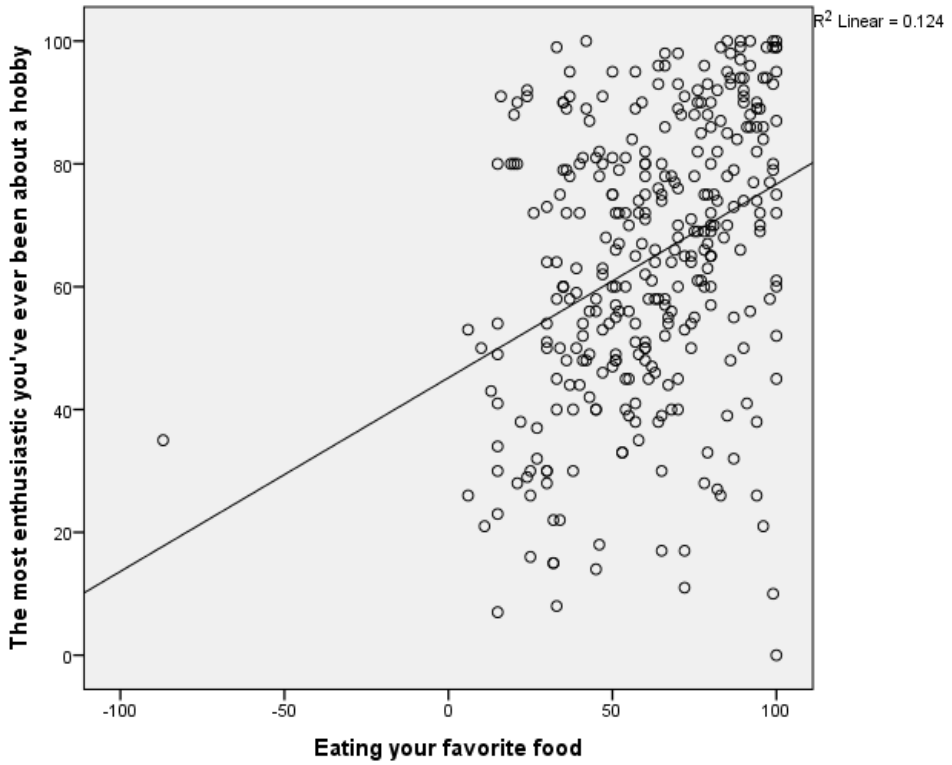

Figure 4-38. Eating your favorite food correlated with The most enthusiastic you've ever been about a hobby

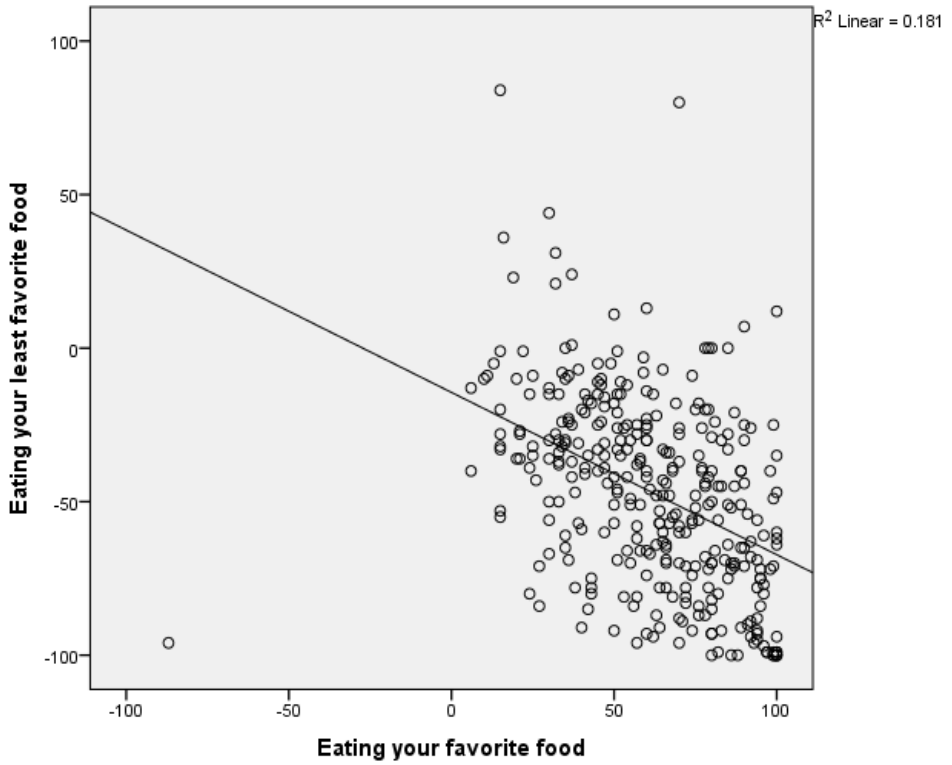

Figure 4-39. Eating your favorite food correlated with Eating your least favorite food

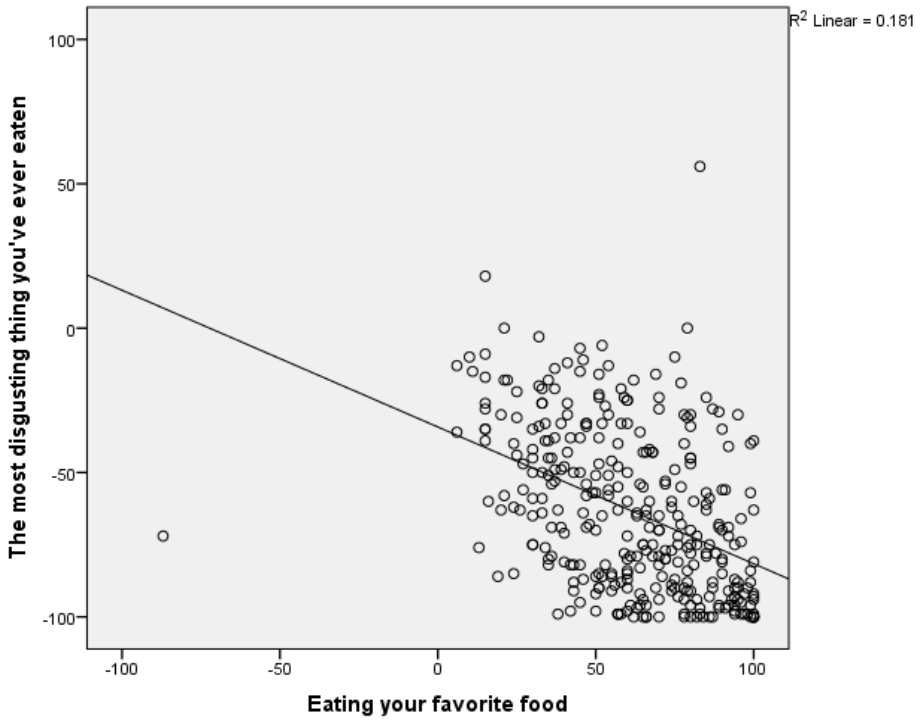

Figure 4-40. Eating your favorite food correlated with The most disgusting thing you've ever eaten

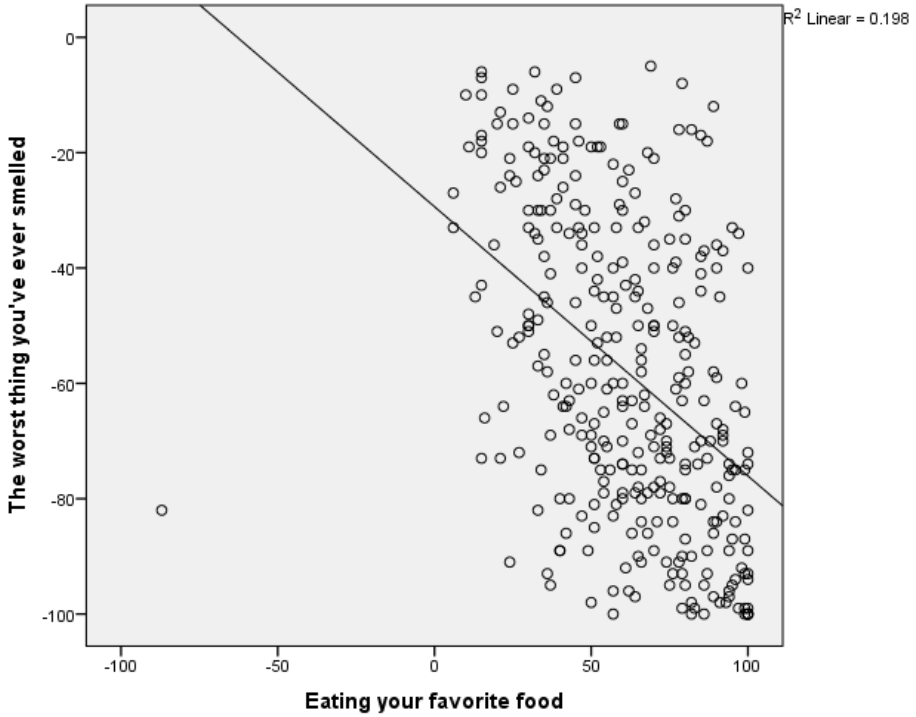

Figure 4-41. Eating your favorite food correlated with The worst thing you've ever smelled

CHAPTER 5
CONCLUSION

Assessing ratings of foods and nonfood affective items using the HgLMS created a portrait of how participants rate items in their lives. Individuals tend to rate affective items more intensely positive and negative than food items. Individuals who are "Foodies" rate both foods and affective items more intensely than do "Nonfoodies." This shows individuals who get greater pleasure from food are also affectively more reactive than those who get less pleasure from food. Foodies feel greater pleasure from positive affective experiences and greater displeasure from negative affective experiences than do Nonfoodies.

Eleven amalgamative groups were created to encompass as many variables as possible. Four groups were foods and seven groups were affective groups. The food groups were High Fat Savory, High Fat Sweet, Sweet, and Alcohol. The seven affective groups were Amusement/Excitement, Anger/Anxiety, Disgust/Fear, Guilt/Shame, Health Related, Satisfaction/Contentment, and Sensory Pleasure.

Significant correlations between the three smell items in our study and the amalgamative groups with the exception of Alcohol show smell is a sense which is highly related to affect. Highly significant correlations (CCs>.500 or <-.500) were seen for the Amusement/Excitement (*Smelling Your Favorite Meal*), Disgust/Fear (*The Worst Thing You've Ever Smelled*), Satisfaction/Contentment (*Smelling Your Favorite Meal* and *Smelling Your Favorite Flower*), and Sensory Pleasure groups (*The Worst Thing You've Ever Smelled, Smelling Your Favorite Meal*, and *Smelling Your Favorite Flower*). The Sensory Pleasure group in particular is important in regards to smell. Since this group included only variables pertinent to the five senses, the high correlation

coefficients of the smell variables with this group show the grouping of the variables did what it aimed to do: it created a cohesive and relevant group of related items which were highly related to the senses.

Correlations between the eight food related affect variables and the amalgamative groups similarly showed food and eating are highly related to affect. Highly significant correlations (CCs >.500 or <-.500) were seen for the Amusement/Excitement (*Finding a Great Restaurant, Getting Invited to Dinner with Friends, Making up a Tasty New Recipe*, and *Eating Your Favorite Food*), Disgust/Fear (*Eating Your Least Favorite Food*), Satisfaction/Contentment (*Finding a Great Restaurant, Getting Invited to Dinner with Friends* and *Making up a Tasty New Recipe)*, and Sensory Pleasure groups (*Finding a Great Restaurant, Getting Invited to Dinner with Friends, Making up a Tasty New Recipe,* and *Eating Your Favorite Food*). These results showed food and eating are highly related not only to affect but specifically to positive, sensory related affect.

Several variables proved to be dichotomous, and individuals tended to rate these variables moderately positively or moderately negatively. However, the mean participant rating was near zero (between -10 and 20). These positive and negative factions differ from one another in their correlations with the amalgamative groups, showing these factions are affectively disparate and should not be treated as a whole for assessment. Dichotomous groups can be identified by a large spread in data, indicated by a high standard deviation in the participant mean rating or by visually assessing the data spread on a regression graph.

Alcohol was a group of particular interest. The spread of the component variables (*Beer, Drinking a Great Glass of Wine, Vodka*, and *Whiskey*) was very large. The Alcohol group yielded non-statistically significant p-values with nearly every group and variable to which it was experimentally correlated. Conversely, all of the other groups showed mostly significant correlations with one another as well as with single variables. Likely, the young age of participants or (median=20) or the rating of alcohols as affective variables rather than foods led to this non-significance.

Further research is needed to solidify the relationship between food and affect. The demographic of this study was limited, with a disproportionate number of participants being young white females. Performing this study in a non-University environment, in different regions, and with different age groups would be beneficial.

APPENDIX A
HGLMS

Name:

Panelist Number:

Now we would like you to create your personal scale.
Please use the spaces provided below to label the anchors (-100 and 100) on your scale.

Strongest **disliking** of any kind that you have experienced	Neutral	Strongest **liking** of any kind that you have experienced
-100	**0**	**100**

To define the BOTTOM of your scale (-100):

Please identify the "strongest disliking of any kind that you have experienced":_____

_____

To define the TOP of your scale (100):

Please identify the "strongest liking of any kind that you have experienced":_____

_____

APPENDIX B
SAMPLE BLOCK RANDOMIZATION OF ALL VARIABLES

Block	Included Variables
1	Ice cream
	The end of an important, special relationship
	Sour cream
	Graduating from high school
	Going to a fun party with friends
	Eating your favorite food
	Whiskey
	Satisfying your curiosity
	The most inspired you've ever been by a lecture
	Milk chocolate
	Your most embarrassing moment
	Being by yourself
	Lasagna
	Entering a haunted house
	Going to the doctor
	The angriest you've ever been
	Honey
	Going to Disney World
2	Having a deadline which seems impossible to meet
	The most annoyed you've ever been
	Learning a new skill
	Making up a tasty new recipe
	Taking medication daily
	Ranch dressing
	Smoked meat
	Hurting someone's feelings
	When someone important to you hurts your feelings
	Cinnamon
	Getting a dental cavity
	Beer
	Grapefruit juice
	Salt
	Meeting a major deadline on time
	Drinking a great glass of wine
	Getting/giving a hug
	Vodka

Block	Included variables
3	Being in a minor car accident
	Getting bad news from your doctor
	Sugar
	Black pepper
	Being made fun of by others
	Being defiant to help correct an injustice
	Needing someone else's help
	Sweets, candy
	Anticipating a test result
	Getting lost
	Falling in love
	Reading a very interesting book
	Peanut butter
	The worst thing you've ever smelled
	Learning a relative has a terminal illness
	Working at your job
	Dark chocolate
	Sausage
4	Whole milk
	Getting caught doing something you're not supposed to
	The most joy you've ever felt
	Orange juice
	Being disrespectful
	Losing your keys
	Meditating or praying
	Getting cut-off in traffic
	Fresh, ripe strawberries
	Being diagnosed with cancer
	Losing 5 pounds
	Taking a test and not knowing how you performed
	Black beans
	Cheddar cheese
	Garlic
	Looking down from a great height
	Getting a great deal on something
	Baked salmon

Block	Included variables
5	Mustard
	Cashews
	Speaking in front of an audience
	Speeding
	A new baby being born into your family
	Collard greens
	Plain broccoli, cooked
	Getting the flu
	Going to the dentist
	Saying you’re going to do something which you know you’re not really going to do
	Learning from your doctor that you only have a few months to live
	Finding a great restaurant
	Lychee
	Getting invited to dinner with friends
	Getting a good grade
	Watching a community suffer through a massive natural disaster
	Breaking an important promise to a loved one
	Talking badly about a friend
6	Dancing
	The funniest joke you’ve ever heard
	Experiencing a natural wonder
	Finding a suspicious looking mole or spot on your body
	Successfully solving a very difficult problem
	Ketchup
	Strawberry yogurt
	Eating your least favorite food
	Watching your favorite team win
	Bananas
	Chips
	A disappointing meal
	Creating a piece of artwork
	Oreo cookies
	Finding a suspicious lump in your breast or testicle
	Bleu cheese
	Cookies, cake, or pastries
	The guiltiest you’ve ever felt

Block	Included variables
7	Riding a roller coaster
	Not knowing which important choice to make
	Ginger
	Pecan pie
	Learning your greatest wish has come true
	Mayonnaise
	Sharing an intimate moment with someone you love
	Accomplishing an important goal
	Being unable to control an important aspect of your life
	Getting dressed and ready for your day
	Trying new exotic foods
	Watching a really funny movie
	Apples
	Smelling your favorite meal
	Telling a lie
	Seeing a roach
	Soy sauce
	Butter
8	Having to use a really dirty bathroom
	Blurting out something you shouldn't have
	Portabella mushrooms
	Lemon flavor
	Onions
	The death of a loved one
	Celery
	The most enthusiastic you've ever been about a hobby
	Seeing a poisonous snake
	Making a new friend
	Catching up with someone special
	Olive oil
	Breaking an important promise to a loved one
	Grape jelly
	Being diagnosed with diabetes
	Not understanding what those around you are talking about
	Curry
	Watching a beautiful sunset

Block	Included variables
9	Mint
	Gardening
	Your proudest moment
	Going to the grocery store
	The most jealous you've ever been
	Hot peppers
	The most ashamed you've ever been of yourself
	Black coffee
	Fried food
	Being in a major car accident
	Wanting something you can't have
	Listening to your favorite music
	Forgetting an old friend's name
	The shyest you've ever been
	Gaining 5 pounds
	Dill pickles
	Beef steak
	Cleaning your house
10	Spaghetti with marinara sauce
	Jello
	Getting a message
	Fruit roll-ups
	Having a reason to believe a problem is about to get better
	Whipped cream
	Spending time with loved ones
	Not getting something you really wanted
	Raw carrots
	The most disgusting thing you've ever eaten
	Your most intense spiritual experience
	Marshmallow
	Watching your favorite TV show
	Smelling your favorite flower
	A full sound night's sleep
	Sugar sweetened drinks
	Finding out no one was hurt in your loved one's accident

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BIOGRAPHICAL SKETCH

Brittany Martin was raised in Palm Bay, Florida. She attended the University of Florida from 2007-2011 where she graduated with a Bachelor of Science degree in food science and human nutrition, with a specialization in food science. During this time she was also a co-op for Campbell Soup Company in Camden, New Jersey. A lifelong interest in food, cooking, and scientific research led her to the food science field; this interest sparked her desire to stay at the University of Florida to work on a Master of Science degree, which she received in May 2013. Brittany will continue studying at the University of Florida to pursue a Doctor of Philosophy in the field of food chemistry.